CONNECTICUT RIVER FLOOD CONTROL PROJECT

CHICOPEE, MASS.

CONNECTICUT RIVER, MASSACHUSETTS

SPECIFICATIONS

FOR

LOCAL PROTECTION WORKS

ITEM C. 4 - HIRED LABOR

WILLIMANSETT DIKE

WAR DEPARTMENT CORPS OF ENGINEERS, U.S. ARMY

U.S. ENGINEER OFFICE, PROVIDENCE, R.I.

CONNECTICUT RIVER FLOOD CONTROL PROJECT

SPECIFICATIONS

FOR CONSTRUCTION OF

DIKES AND STOP-LOG STRUCTURE, WILLIMANSETT SECTION

ITEM C.4 (HIRED LABOR)

CHICOPEE, MASSACHUSETTS

JANUARY 15, 1940

CORPS OF ENGINEERS, U. S. ARMY

U. S. ENGINEER OFFICE PROVIDENCE, R. I.

SECTION I. GENERAL PROVISIONS

DETAILED SPECIFICATIONS

WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE
PROVIDENCE, RHODE ISLAND

APPROPRIATION: EMERGENCY RELIEF, 1938-1940
21x3113 FLOOD CONTROL, GENERAL.

DIKE AND STOP-LOG STRUCTURE, WILLIMANSETT SECTION
ITEM C.4 (HIRED LABOR)
CHICOPEE, MASSACHUSETTS

S P E C I F I C A T I O N S

SECTION I. GENERAL PROVISIONS

1-01. Location. - The site of the work covered by these specifications is located on the east bank of the Connecticut River, in the north (or Willimansett) portion of the City of Chicopee, Massachusetts.

1-02. Work to be done. - a. The work provided for herein is authorized by the Emergency Relief Appropriation Act of 1938-1940, and by the Flood Control Act of June 28, 1938 (Public No. 761, 75th Congress).

b. The work to be done consists of furnishing all plant, labor and materials and performing all work required for constructing earth dikes and a concrete stop-log structure, complete in accordance with these specifications and the drawings forming a part hereof, together with such incidental work as needed or ordered in writing by the District Engineer. It will consist of the following principal items of construction:

(1) Construction of earth dikes between dike stations 0+30 and 4+70, and between dike stations 10+22 and 11+89.

(2) Construction of a concrete stop-log structure.

(3) Relocation of Willimansett Brook channel from Station C 0+00 to Station C 3+50.

1-03. Organization. - The work described in these specifications will be executed by the Area Engineer whose responsibility shall correspond to that of "contractor" as defined in Article 1, standard construction contract form No. 23. The District Engineer as the officer responsible for the final accomplishment of the work specified will correspond to the "contracting officer."

1-04. Responsibility of the District Engineer. - a. The District Engineer will decide all questions which may arise as to performance, quantity and quality, acceptability, fitness and materials to be furnished and used, and the rate of progress of the work as described by these specifications and will decide all questions which may arise as to interpretations of the specifications and drawings.

b. Changes which are necessary due to changed conditions in the field and necessitate a change in the specifications or drawings will be made in writing by the District Engineer provided that any change involving an estimated increase or decrease of more than $500 will be subject to the final approval of the Chief of Engineers, U. S. Army.

c. The work will be conducted under the general direction of the District Engineer and will be inspected by inspectors appointed by him. The organization of the inspection staff will be entirely separate from the Area Engineer's organization and will be directly responsible to the District Engineer. It is understood that any instructions given by the District Engineer through an inspector or other authorized employee are to be considered instructions or decisions of the District Engineer in all cases.

1-05. Description of project. - a. The dikes will be of the rolled-fill type, about 167 feet long and 440 feet long, with a maximum height of about 10 feet. The dikes will be of random material with a cut-off and blanket on the riverside of selected impervious material. The slopes of the dikes will be sodded and seeded as indicated on the drawings. The crest of the dikes will be covered with a layer of compacted gravel or crushed stone. Crushed stone and concrete pipe drains will be installed to provide proper drainage for the landside toe of the dikes.

b. The stop-log structure will be constructed of reinforced concrete with a sheet pile cut-off.

1-06. Drawings. - a. The work shall conform to drawings marked, "Chicopee Dike, Willimansett Section, Hired Labor, Connecticut River, Massachusetts," as listed below, which drawings form a part of these specifications and are filed in the United States Engineer Office, Providence, Rhode Island.

LIST OF DRAWINGS

Sheet No.	Title	File No.
1	Project Location and Index	CT-4-2014
2	Subsurface Exploration	CT-2-1198
3	Borrow Areas	CT-2-1199
4	General Plan	CT-4-2015
5	Plan and Profile	CT-4-2016
6	Embankment Details	CT-4-2017

LIST OF DRAWINGS (Cont.)

Sheet No.	Title	File No.
7	Montgomery Street Ramp	CT-4-2018
8	Drainage Profile and Details	CT-4-2019
9	Seep Rings and Guard Rail Details	CT-4-2020
10	Stop-Log Concrete Details	CT-4-2021
11	Stop-Log Sheet Steel Piling	CT-4-2022
12	Stop-Log Steel Reinforcement No. 1	CT-4-2023
13	Stop-Log Steel Reinforcement No. 2	CT-4-2024
14	Stop-Log Steel Casting Details	CT-4-2025
15	Stop-Log Bar Schedule No. 1	CT-4-2026
16	Stop-Log Bar Schedule No. 2	CT-4-2027

b. The work shall also conform to such other drawings relating thereto used in explanation of details or minor modifications as may be furnished by the District Engineer from time to time during construction.

1-07. Quantities. - The following estimate of quantities is given to serve as an indication of the extent of the work covered by these specifications:

Item	Designation	Unit	Quantity
1	Preparation of Site	acre	0.9
2	Stripping	cu. yd.	1,480
3	Common Excavation - General	" "	1,500
4	Impervious Borrow Excavation	" "	3,200
5	Random Borrow Excavation	" "	4,680
6	Common Excavation - Cut-Off Trench	" "	640
7	Removal of Existing Structures		
	a. Concrete Pavement and Sidewalks	" "	20
	b. Granite Curb	lin. ft.	20
8	Steel Sheet Piling	sq. ft.	650
9	Impervious Fill, Placing and Rolling	cu. yd.	3,200
10	Random Fill, Placing and Rolling	" "	4,680
11	Gravel Bedding	" "	260
12	Semi-Compacted Backfill	" "	240
13	Riprap, Hand-Placed	" "	140
14	8-Inch Porous Concrete Pipe	lin. ft.	500
15	8-Inch V.C. Pipe	" "	160
16	Cement	bbl.	113
17	Concrete in Stop-Log Structure	cu. yd.	67
18	Concrete in Miscellaneous Structures	" "	4
19	Concrete in Road and Sidewalk Paving	sq. yd.	130
20	Steel Reinforcement	lb.	6,700
21	Miscellaneous Structural Steel	"	1,600

Item	Designation	Unit	Quantity
22	Miscellaneous Iron and Steel	lb.	500
23	Timber Stop-Logs	M.F.B.M.	2.6
24	Topsoil	cu. yd.	1,000
25	Sodding and Seeding	acre	0.8
26	Gravel Surfacing for Top of Dike	cu. yd.	90
27	Gravel for Roads	" "	250
28	Bituminous Macadam Road Surface	sq. yd.	690
29	Manholes	each	2
30	Highway Cable Guard Rail	lin. ft.	400
31	Granite Curb	" "	20
32	Cast Iron Pipe, 12-Inch	" "	16

1-08. Physical data. - a. General. - Materials for constructing the earth dike are available in the vicinity of the work. Locations of borrow area are shown on the drawings. Borings and test pits have been made in the vicinity of the proposed work with reasonable care and substantially at the places indicated on the drawings. Laboratory analyses have been made of the samples from many bore holes and test pits. Samples of materials taken from them, and records of laboratory analyses and results of other studies may be seen at the United States Engineer Office, Providence, Rhode Island.

b. Transportation facilities. - (1) Railroads. - The Boston and Maine Railroad serves the City of Chicopee with main line traffic. The Area Engineer shall investigate the availability of the sidings from the railroad company and make all arrangements with the latter for the use of any sidings for the delivery of any materials and equipment to be used on the work.

(2) Highways. - First-class highways also serve the city. The Area Engineer shall provide for his own construction or access roads and their maintenance. He shall make his own investigation of available roads for transportation, of load limits for bridges and roads, and other road conditions affecting the transportation of materials and equipment to the site of the work.

c. Weather conditions. - The locality is subject to atmospheric temperatures ranging from minus 20 degrees to plus 105 degrees Fahrenheit. The mean annual precipitation at Chicopee is 43.62 inches. The mean monthly precipitation varies from a low of 3.20 inches in April to a high of 4.31 inches in July.

1-09. Lands, rights of way, damages. - The District Engineer will designate the lands, rights of way and easements which will be required for the project, and the Area Engineer shall undertake the construction only when directed by the District Engineer.

1-10. Removal of rubbish. - The Area Engineer shall keep the

site free from rubbish. Suitable spoil areas for receiving refuse from the grounds shall be provided, and the rubbish shall be removed and disposed of as directed by the District Engineer and in a manner agreeable to the local interests and in accordance with the sanitary provisions of Paragraph 1-18. At the conclusion of the work, the site shall be cleaned up and all rubbish and unused materials shall be disposed of in accordance with Paragraph 11-10.

1-11. Datum and bench marks. - The plane of reference of mean sea level as used in these specifications is that determined by the following bench mark:

T.B.M. #4 (U.S.C. & G.S.)

At Chicopee, Hampden County, about 100 yards south of the railroad station, at the southeast corner of the base of Semaphore #32. The top of an iron bolt. Elevation 81.332 feet M.S.L.

1-12. Lines, grades, stakes and templates. - The Government inspector will define and approve on request all points and elevations reasonably necessary for the prosecution of the work from lines and grades established by the survey party.

1-13. Planimeter. - For the estimating of quantities in which computation of area by arithmetic and geometric methods will be comparatively laborious, the planimeter shall be considered an instrument of precision adapted to the measurement of such areas unless otherwise directed by the District Engineer. Measurement of quantities in place after compaction will be used for cost keeping data.

1-14. Responsibility for work. - The Area Engineer shall be responsible for the work and take all precautions for preventing injury to persons and property in or about the work.

1-15. Borrow areas. - Borrow areas will be furnished by the local interests without cost to the Government, including rights of way for transportation purposes across property not owned. If sufficient material is not available in the borrow areas indicated on the drawings or otherwise provided to complete the work, additional areas will be furnished without cost to the Government.

1-16. Soil classification. - a. Soil classifications as referred to in these specifications conform to descriptive terms and limits of classifications as shown on Table No. 1, "Soil Classification", and Plate No. 1, "Diagram Showing Limits of Soil Classes", both of which form a part of these specifications.

b. Table No. 1 - Soil Classification.
(See Page 6 for Table No. 1)

c. Plate No. 1 - Diagram Showing Limits of Soil Classes.
(See Page 7 for Plate No. 1)

PROVIDENCE SOIL CLASSIFICATION
U. S. ENGINEER OFFICE
PROVIDENCE, R. I.

TABLE NO. 1

CLASS	DESCRIPTION OF MATERIAL
1	Clean Gravel. - Contains little coarse to medium sand.
2	Uniform Coarse to Medium Sand. - Contains little gravel and fine sand.
3	Variable - Graded from Gravel to Medium Sand. - Contains little fine sand.
4	Uniform Medium to Fine Sand. - Contains little coarse sand and coarse silt.
5	Variable - Graded from Gravel to Fine Sand. -Contains little coarse silt.
6	Uniform Fine Sand to Coarse Silt. - Contains little medium sand and medium silt.
7	Variable - Graded from Gravel to Coarse Silt. Contains little medium silt.
8	Uniform Coarse to Medium Silt. - Contains little fine sand and fine silt.
9	Variable - Graded from Gravel to Medium Silt. - Contains little fine silt.
10	Uniform Medium to Fine Silt. - Contains little coarse silt and coarse clay. Possesses behavior characteristics of silt.
10 C	Uniform Medium Silt to Coarse Clay. - Contains little coarse silt and medium clay. Possesses behavior characteristics of clay.
11	Variable - Graded from Gravel or Coarse Sand to Fine Silt. Contains little coarse clay.
12	Uniform Fine Silt to Medium Clay. - Contains little medium silt and fine clay (colloids). Possesses behavior characteristics of silt.
12 C	Uniform Clay. - Contains little silt. Possesses behavior characteristics of clay.
13	Variable - Graded from Coarse Sand to Clay. - Contains little fine clay (colloids). Possesses behavior characteristics of silt.
13 C	Variable Clay. - Graded from sand to fine clay (colloids). Possesses behavior characteristics of clay.

PROVIDENCE DISTRICT SOIL CLASSIFICATION

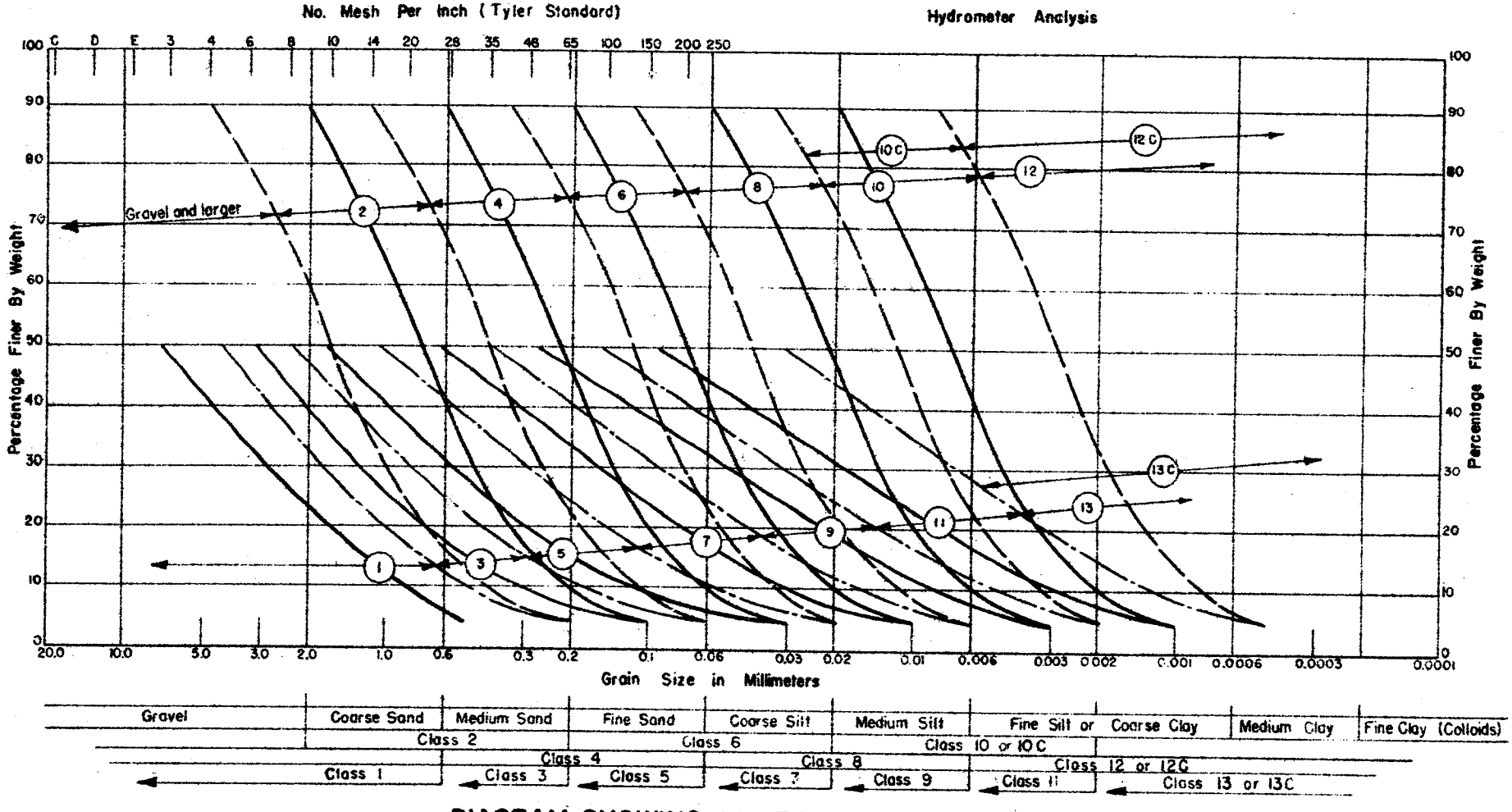

DIAGRAM SHOWING LIMITS OF SOIL CLASSES

1-17. Material purchased by the District Engineer. - All orders, shipping bills or memoranda accompanying material purchased by the District Engineer shall clearly indicate weights and shall be so worded or marked that each item, piece or member can be definitely identified on the drawings.

1-18. Liability and safety requirements. - a. The Area Engineer shall be responsible that his employees strictly observe the laws of the United States affecting all operations at the site under the project. He shall comply with all applicable Federal and State laws under which he is operating, including those concerning the inspection of boilers, hulls, and other equipment, the licensing of engineers, masters and other employees.

b. The Area Engineer shall conduct the work with due regard to adequate safety and sanitary requirements and shall maintain his plant and equipment in safe condition. He shall conform to current safety engineering practices as set forth in the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America; the publications of the National Safety Council, and with all applicable state or local safety and sanitary laws, regulations and ordinances.

c. The District Engineer will require such safety and sanitary measures to be taken as the nature of the work and the conditions under which it is to be performed, demand. Such measures shall include:

(1) The provision of adequate extinguishers or fire-fighting apparatus in and about all buildings and plant erected or used at the site of the work;

(2) Adequate first aid and life saving equipment;

(3) Adequate illumination during night operations;

(4) Watchman service at any railroad crossings used by employees for access to the site;

(5) Warning lights between sunset and sunrise and during fogs, on all cofferdams, vessels, range piles and other obstructions placed in navigable waters during the progress of the work;

(6) Danger lights and barricades, in accordance with the laws of the State of Massachusetts, on all intercepted highways and on such obstructions and hazards which encroach on, or are adjacent to, public rights of way;

(7) Instruction in accident prevention to reach all employees;

(8) Such machinery guards, safe walkways, scaffolds, ladders, bridges, gang planks and other safety devices, equipment and

apparel as are necessary to prevent accidents or injuries.

d. The Area Engineer shall report promptly to the District Engineer in form prescribed by him all accidents occurring at the site of the work.

1-19. Use of explosives. - All blasting shall be done in the most careful manner so as not to endanger life, property, or the work. Explosives used shall be of a quality and power approved by the District Engineer. Dynamite in a frozen condition shall not be used. Approved explosives shall be stored before use in a suitable magazine, in an approved location, in compliance with state and local laws and regulations. Detonators shall be kept in a separate magazine not less than 100 feet from the explosives magazine. Magazines shall be plainly marked with large letters "EXPLOSIVES - DANGEROUS" and shall be kept locked. Accurate daily records shall be kept to account for each piece of explosive and detonator from the time of delivery at the magazine until its discharge in use.

1-20. Order of work. - The work covered by these specifications shall be commenced on the date designated by the District Engineer and shall be completed on or before June 30, 1940. The work shall be carried on at such localities and in such order of precedence as may be found necessary by the District Engineer. The location and limits of the work to be done will be plainly indicated by the District Engineer or his agents by stakes or otherwise. The District Engineer may suspend the work wholly or in part for such periods as he may deem necessary on account of conditions considered unfavorable for the suitable prosecution of the work.

1-21. Plant organization. - a. The Area Engineer shall provide sufficient plant of size suitable to meet the requirements of the work and shall maintain the plant and equipment in such condition as to perform the work efficiently and economically within the time specified. An ample force shall be maintained to conduct the work properly and efficiently.

b. No reduction in the capacity of the plant employed on the work shall be made except when approved by the District Engineer. The measure of the "capacity of the plant" shall be its actual performance on the work to which these specifications apply.

1-22. Employment of labor. - The method of employment, rate of wages, and monthly hours of employment for the various classifications of workmen shall be in strict conformity with the schedule (or any authorized revision thereof) furnished by the Work Projects Administration for Chicopee. The District Engineer will report to the Department of Labor within five days after the close of each calendar month on forms to be furnished by the Department of Labor, the number of persons employed on the project, the man-hours worked and the total expenditure for materials. No work shall be done on Sundays or on days declared by

Congress as holidays for per diem employees of the United States except in cases of emergency, and then only with the written consent of the District Engineer. Night work, when necessary to maintain operating schedules, will be permitted upon written approval of the District Engineer. (See Paragraph 1-20.)

1-23. Purchase of supplies and materials. - a. Because the materials listed below, or the materials from which they are manufactured, are not mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality, their use in the work herein specified (subject to the requirements of the specifications) is authorized without regard to the country of origin:

Platinum	Nickel	Asbestos
Chromium	Rubber	China wood oil (tung oil)
Cork	Teakwood	Balsa wood
Jute	Silk	English ball clay
Kauri gum	Sisal	English china clay
Lac	Tin	Natural copper nickel alloy (monel metal)

b. Articles, materials, or supplies, manufactured in the United States and containing mercury, antimony, tungsten, or mica of foreign origin may be used (subject to the requirements of the specifications) in the work herein specified because such manufactured articles, materials, or supplies have been manufactured in the United States substantially all from articles, materials, or supplies mined, produced, or manufactured, as the case may be, in the United States.

1-24. Quality and inspection of supplies and materials. - a. All materials, supplies and articles used shall be, insofar as is practicable, the standard stock products of recognized and reputable manufacturers and shall be sufficient in strength, durability, usefulness and convenience for the purpose intended. All materials, parts and equipment shall be of the highest grade, free from defects and imperfections, of recent manufacture and unused. Workmanship shall be of the highest grade and in accordance with the best modern practice.

b. All materials, supplies, and parts and assemblies thereof, purchased for the work covered by these specifications, shall be inspected in conformity with modern approved methods as directed by the District Engineer. Unless waived in writing by the District Engineer, all tests and trials shall be made in the presence of a duly authorized representative of the District Engineer. When the presence of the inspector is so waived, sworn statements, in duplicate, of the tests made and results thereof shall be furnished the District Engineer by the supplier. All costs of all tests and trials excepting the expenses of the Government inspector shall be borne by the supplier.

1-25. Cost accounting. - a. The Area Engineer shall keep an accurate cost distribution record of all work done and shall submit a monthly cost report to the District Engineer. The cost shall be kept so that proper charges may be made against the items in Paragraph 1-07.

b. A separate account shall be kept of all labor charges in order that employees' compensation insurance may be determined.

c. The cost and expense of inspection and surveys shall be kept separately and not included in the actual cost of performing the work.

d. Prior to the commencement of the work, the Area Engineer shall prepare a Job Estimate Summary Sheet (Form No. 18 Costs) in quadruplicate and forward same to the District Engineer, attaching thereto the engineering estimate for performing the work. The final cost shall reflect all charges contemplated in the estimate.

e. Nothing in this paragraph shall be construed as changing the method by which costs are now reported in monthly and annual reports required by the cost keeping manual.

1-26. Protection of existing structures. - a. During construction operations, on work covered by these specifications, the Area Engineer shall protect all existing structures and accepted work. Any disturbances or damage to any structures by operations under these specifications shall be repaired promptly by the Area Engineer without credit to the work.

b. Care shall be taken to cause no interruption of service or other damage to the Boston & Maine Railroad because of construction operations adjacent to the railroad, as shown on the drawings or required by the District Engineer.

1-27. Final examination and acceptance. - As soon as practicable after the completion of any section of the work as in the opinion of the District Engineer will not be subject to injury by further operations under these specifications, such section may be examined as deemed advisable by the District Engineer. The District Engineer will make a thorough examination of same and if it is found to comply fully with the requirements of the specifications, it will be accepted.

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SECTION II. PREPARATION OF SITE (Item 1).

2-01. Work included. - Clearing, grubbing, and disposal of materials shall be done as directed by the District Engineer, within the limits shown on the drawings or as staked in the field.

2-02. Clearing. - a. Clearing shall include all necessary portions of the following areas: (1) The area within the limits of the foundation of the required earth dikes, together with a 5-foot strip measured horizontally beyond and contiguous to the toe line on each side of the dikes, (2) borrow areas, (3) the areas within the working limits of the foundation of the stop-log or other proposed structures, (4) the relocated channel area, and (5) portions of the river bank or any other area designated by the District Engineer within the limits shown on the drawings.

b. Trees and other obstructions shall be removed by the Area Engineer from the sites of the proposed structures and of the borrow areas when and as directed by the District Engineer and may be removed from other areas only to the extent directed or permitted. The Area Engineer shall preserve and protect from injury all trees not required to be removed.

c. All timber, undergrowth, brush, logs, weeds, and debris of any nature shall be cleared and removed from the site of the work as directed by the District Engineer.

2-03. Grubbing. - a. The areas to be grubbed shall include the foundation area for the dikes and other areas as may be directed by the District Engineer.

b. All such areas shall be thoroughly grubbed of all stumps, roots, buried logs, and other objectionable matter. Tap roots and other projections over 1-1/2 inches in diameter within the limits of the stop-log structure and the dikes shall be grubbed out to a depth at least 3 feet below the ground surface, unless otherwise directed by the District Engineer.

2-04. Removal of structures. - The removal of existing structures and utilities required to permit the orderly prosecution of the work covered by these specifications will be accomplished by local agencies unless otherwise shown on the drawings. Whenever a telephone or telegraph pole, pipe line, conduit, fence, sewer or other utility is encountered and must be removed to permit completion of the work, the District Engineer will notify the proper local authorities, and the designated utility will be removed promptly.

2-05. Disposal of materials. - All materials removed, as specified above, shall be disposed of by burning or by removal to approved disposal areas as directed. No material shall be thrown into or left along

the bank of the river. The disposal of material shall closely follow the operations of clearing and grubbing so that brush and other debris will not be washed into the river in case of high water. At no time shall material be placed on land adjacent to the construction area. No damage of any nature shall be inflicted upon adjoining property owners by unwarranted entry or disposal of material on adjacent property.

2-06. Measurement and credit. - The quantity to be credited under Item 1 will be the number of acres cleared. Credit for all work in connection with the preparation of the site as above specified, including the loading, hauling, and disposal of the materials, will be made under Item 1, "Preparation of Site".

SECTION III. EXCAVATION (Items 2 to 7 incl.)

3-01. General provisions. - a. Scope of work. - The location and character of the proposed structures and the location and logs of borings and test pits are shown on the drawings (see Paragraph 1-06). It is the intent of the Government that excavation be made to the lines and grades given thereon but the right is reserved to modify any part of the work, if, in the opinion of the District Engineer, conditions require such modification.

b. Disposal of material. - (1) Material from the excavations, except stripping, shall be used, if possible, in the permanent construction as directed by the District Engineer. No material, except stripping, shall be wasted unless specifically authorized by the District Engineer. If, at the time of excavation, it is not possible to place the material in the proper section of the permanent construction, it shall be stock-piled in approved areas for later use. Materials from the excavation that are unacceptable for use in the permanent construction shall be wasted in spoil areas in approved locations as directed by the District Engineer. Upon completion of the work, spoil areas shall be graded and dressed neatly to the satisfaction of the District Engineer.

(2) Topsoil and sod obtained from the stripping operation shall be stock-piled in approved locations to be used later in the locations shown on the drawings, unless otherwise authorized by the District Engineer.

(3) Road surfacing material obtained from the stripping operation at the stop-log structure or other locations shall be stock-piled in approved locations to be replaced as shown on the drawings, or otherwise disposed of as directed by the District Engineer.

c. Measurement. - (1) Excavation for structures will be measured in place and the volume thereof will be computed between the original ground surface as determined by a survey made just prior to the commencement of the work and the excavation lines shown on the drawings.

(2) Where excavation lines are not shown on the drawings, measurement will be made of the volume between the original surface as determined from the survey made just prior to the commencement of the work and the lines and grades established by the District Engineer.

d. Credit. - (1) Items included. - Credit for the various classes of excavation shall include the cost of all labor, plant and incidentals, for excavating, loading, hauling and disposal of the material in the embankment or spoil areas, including any stock-piling and rehandling, and the grading and dressing of spoil areas.

(2) Construction roads. - The cost of construction and maintenance of roads and bridges for the Area Engineer's use will not be credited under a separate item but shall be included in the credits for the other items of work.

(3) Excavation lines. - Credit for all structure excavations will be made to the excavation or slope lines shown on the drawings regardless of whether or not it is necessary to remove the material to slopes greater or less than those shown. No credit will be made for excavation outside of the limits described above; the Area Engineer will be required to backfill any such excess excavation with approved material, or with additional concrete where excess excavations are adjacent to concrete structures, without additional credit.

(4) Shoring. - Where approved by the District Engineer, shoring may be used in lieu of excavation to the slope or excavation lines shown on the drawings. The Area Engineer shall be responsible for the unfinished work, and that workmen shall be safe from danger of caving or slides while making structure excavations. Shoring shall be erected in a safe and workmanlike manner, and shall be placed in such a way as to afford ready inspection of and ample clearance for the permanent work. Shoring shall be removed upon completion of the permanent work or as soon as the construction does not require its use. No credit will be made for temporary shoring but the cost thereof shall be included in the credit for the excavation.

(5) Temporary drains. - The Area Engineer shall maintain the site of the work and adjacent grounds in a well drained condition. Temporary drains and ditches required shall be constructed by the Area Engineer without additional credit.

(6) Additional credit. - Additional credit will be made to replace portions of the river bank and dike washed out by flooding or scouring, or that required to be removed on account of slides, or for the removal and disposal of all objectionable materials; provided such replacement of material was not caused by negligence of the Area Engineer. Quantities for additional credit will be measured as directed by the District Engineer, and credit will be made under the applicable items.

3-02. Classification. - All materials excavated will be classified as follows:

a. Common excavation shall include the removal of all materials except stripping to the lines and grades shown on the drawings or established by the District Engineer.

b. Detailed classification is as follows:

(1) Stripping (Item 2) (see Paragraph 3-03).
(2) Common Excavation (see Paragraphs 3-04, 3-05 and 3-06).
General (Item 3).
Borrow Area (Items 4 and 5).
Cut-off Trench (Item 6).
(3) Removal of Existing Structures (Item 7) (see Paragraph 3-07).

3-03. Stripping (Item 2). - a. Work included. - The Area Engineer shall strip the area to be covered by the earth dikes to a sufficient depth to remove all material not suitable for the foundation of the dike as directed by the District Engineer. The unsuitable materials to be removed shall include sod, topsoil, rubbish below the ground surface not removed by clearing and grubbing, all loose weathered, or otherwise unsatisfactory rock and any other objectionable material. The maximum depth of excavation classified as "stripping" shall be 3 feet. Any additional excavation required to remove unsuitable material shall be classified as "common excavation - general," unless otherwise directed by the District Engineer. The portion of the highway adjacent to the stop-log structure, as shown on the drawings, shall be broken up and removed.

b. Disposal of materials. - The provisions of Paragraph 3-01b shall apply.

c. Measurement and credit. - Measurement will be made in accordance with Paragraph 3-01c. Credit for all work in connection with stripping, including the loading, hauling, disposal of the materials, and all stockpiling and rehandling required, will be made under Item 2, "Stripping" (see Paragraph 3-01d).

3-04. Common excavation - general (Item 3). - a. Work included. - The Area Engineer shall excavate and dispose of the materials classified as common excavation - general above and below the mean water level in the river to the lines and grades shown on the drawings for the respective areas, or as otherwise directed by the District Engineer. Excavation shall be performed in accordance with a schedule of operations to be approved by the District Engineer. Common excavation - general includes excavation for the foundation of the stop-log structure, for the relocated channel, for the earth dikes additional to that included under Items 1 and 2, and any other required common excavation for structures, drains and ditches not included in other items of the work.

b. Description. - Excavations shall be made wide enough to permit proper sheeting, bracing and form work where necessary. Foundations for the concrete stop-log structure shall be excavated as directed by the District Engineer to suitable undisturbed foundation material approved by the District Engineer.

c. Shoring. - See Paragraph 3-01 d(4).

d. Sheeting and pumping. - The Area Engineer shall provide all necessary pumps to unwater the site properly and to keep the site free from water during such time as the work is under construction, and shall provide all necessary bulkheads, drains, etc., to prevent running water from coming in contact with newly placed concrete or concrete being placed in excavated areas.

e. Disposal of materials. - The provisions of Paragraph

3-01b shall apply. Excavated materials not used in permanent construction may be used in temporary construction if approved by the District Engineer.

f. Measurement and credit. - See Paragraph 3-06 d.

3-05. Common excavation - borrow areas (Items 4 and 5). - a. Work included. - The Area Engineer shall excavate impervious borrow excavation and random borrow excavation, in the indicated borrow area or other approved areas, the materials to be used in the dike or miscellaneous fills. Excavation shall include the transportation of the material to the point of disposal. The borrow areas shall be stripped to the limits established by the District Engineer. To provide suitable fill materials, excavations shall be made to the depths and in the locations as directed by the District Engineer. During and after excavation the borrow areas shall be graded so that all surface water will drain readily from them. The borrow areas shall be dressed smoothly and evenly, left in a neat condition satisfactory to the District Engineer, and shall be graded so that the slopes blend into the surrounding topography.

b. Disposal of materials. - The provisions of Paragraph 3-04e shall apply.

c. Measurement and credit. - See Paragraph 3-06d.

3-06. Common excavation - cut-off trench (Item 6). - a. Work included. - The Area Engineer shall excavate and dispose of the materials in the cut-off trench for the earth dikes, both above and below the mean water level in the river to the lines and grades shown on the drawings, or as otherwise directed by the District Engineer. The required depth of the cut-off trench at all points cannot be known with certainty until the area is fully developed by the construction operations. The lines and grades shall include any necessary adjustment to field conditions.

b. Pumping and draining. - The Area Engineer shall do all pumping and draining necessary to perform the excavation in the dry, and to keep the cut-off trench unwatered until it has been satisfactorily backfilled with suitable material.

c. Disposal of materials. - The provisions of Paragraph 3-04e shall apply.

d. Measurement and credit. - Measurement for excavation work under Items 3 to 6, inclusive, will be made as specified in Paragraph 3-01. Credit for all work in connection with excavation under Items 3 to 6, inclusive, including the loading, hauling and disposal of the materials, as specified in Paragraph 3-01d, will be made at the applicable credit for Items 3 to 6, inclusive. Stripping of borrow areas will be credited to the work under Items 4 or 5 as applicable.

3-07. Removal of existing structures (Item 7). - a. Work included. - The Area Engineer shall excavate and dispose of the materials in the existing structures as shown on the drawings, and classified as follows:

Item 7(a). Concrete pavement and sidewalks.
Item 7(b). Granite curb.

The concrete fragments shall be broken to sizes suitable for satisfactory disposal in spoil areas as directed by the District Engineer. Granite curbing shall be saved for reuse (see Paragraph 11-08).

b. Blasting. - (1) In general, removal of existing structures may be accomplished without blasting. If blasting is found to be necessary, the use of explosives shall be conducted as provided for in Paragraph 1-19.

(2) Blasting will be permitted only when proper precautions are taken for the protection of all persons, the work and the property. All damage done to the work or the property shall be repaired by the Area Engineer without additional credit. All operations of the Area Engineer in connection with the transportation, storage, and use of explosives shall be as approved by the District Engineer.

(3) Explosives of such quality and power shall be used in the locations which will, in the opinion of the District Engineer, neither crack nor damage the work outside the lines of excavation. Blasting shall be done only to the lines and grades shown on the drawings or approved by the District Engineer.

(4) Approval by the District Engineer of the method of blasting or the strength and amount of the explosive used, will not relieve the Area Engineer of his responsibility in the blasting operations.

c. Disposal of materials. - Excavated materials shall be disposed of in designated spoil areas as provided in Paragraph 3-01.

d. Measurement and credit. - The quantity to be credited under Item 7(a) will be the number of cubic yards excavated and satisfactorily disposed of in accordance with the drawings or as directed. The quantity to be credited under Item 7(b) will be the number of linear feet excavated and stock-piled for reuse, or otherwise disposed of as directed. Measurement will be made to the neat lines of the structure before removal. Credit for all work in connection with excavation under Item 7, including the loading, hauling and disposal of the materials, will be made under Items 7(a) and 7(b). (See Paragraph 1-07).

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SECTION IV. STEEL SHEET PILING (Item 8)

4-01. Work included. - The Area Engineer shall construct the steel sheet piling cut-off under the stop-log structure as shown on the drawings. The cut-off shall be constructed of piles of varying lengths, including specials, driven to grade, between the limits as shown on the drawings or as directed by the District Engineer.

4-02. Type and properties. - The piles shall be of approved commercial type and shall have a minimum thickness of metal of 3/8 inch, except that a reasonable reduction for shaping the joints of the interlock will be permitted. The piles shall provide a section modulus of not less than 5.4 inches cubed per linear foot of cut-off, and shall weigh not less than 22 pounds per square foot of cut-off, see drawing sheet No. 11, exclusive of any welded or riveted connection or reinforcement. The interlocked joints shall develop a strength in direct tension of not less than 8,000 pounds per linear inch of interlock without rupture. The piles shall be continuously interlocked throughout their entire length and shall be provided with standard pulling holes. The type and dimensions of the piles the Area Engineer proposes to furnish shall be submitted to the District Engineer for approval before any piles are delivered to the work.

4-03. Material. - The steel for the sheet piling shall be new and shall conform to Federal Specification QQ-S-751a for "Steel: Structural (Including Steel for Cold Flanging) and Steel: Rivet (for) Ships other than Naval Vessels," Structural Grade, except for the following requirements:

a. Tensile strength shall be not less than 70,000 pounds per square inch, except that fabricated sections such as corner piles, toe piles and other special sections shall be of steel having a tensile strength of not less than 60,000 pounds per square inch.

b. Elongation in 8 inches, minimum, percent $\frac{1,400,000}{\text{tensile strength}}$.

c. Bend test specimens shall withstand bending 180 degrees around a pin with a diameter twice the thickness of the specimen without fracture on the outside of the bend.

4-04. Driving. - The piles shall be driven to form a continuous interlocking diaphragm down to the elevation established for the bottom of the cut-off, as shown on the drawings. Special care shall be taken to avoid damage to sewers, drains, and conduits encountered in the work. A protecting cap shall be used in driving. The hammers shall be of a suitable size and type, either steam or air operated. The use of a water jet may be permitted at the discretion of the District Engineer. Piles shall be driven without injury to them, as true to line and grade as possible, and shall be cut off, where necessary, to the top elevation of the sheet piling cut-off and

trimmed to vertical lines at steps in the foundations as shown on the drawings. Proper precautions shall be taken to prevent rupture at the interlocks. Piles ruptured at the interlock or otherwise injured shall be removed and replaced by new piles without additional credit.

4-05. Measurement and credit. - The quantity of steel sheet piling to be credited will be the number of square feet of steel sheet piling actually in place as shown on the drawings. Credit will be made under Item 8, "Steel Sheet Piling," and shall include the costs of all labor, materials, equipment and incidentals required to construct the permanent sheet piling cut-off as specified. Credit for lengths of piling in excess of those required by the drawings or ordered by the District Engineer will not be allowed.

SECTION V. EARTH DIKE (Items 9 and 10).

5-01. Definitions. - The term "embankment" as used in these specifications includes earth fill of all types for the earth dikes and cut-off trench, and all other specified or directed earth fills within the limits of the dikes shown on the drawings. The various types of earth fill are "Selected Impervious" under Item 9, for the cut-off trench and the blanket on the riverside of the embankment, and the "random" under Item 10, forming the entire fill except the impervious section.

5-02. Work included. - The Area Engineer shall grade and consolidate materials required for the embankment, to the elevations, lines, grades and cross sections shown on the drawings. The Area Engineer shall use suitable materials, as approved by the District Engineer.

5-03. Materials. - a. General. - All materials from required excavations shall be used in the embankment, if, as excavation proceeds, they are found suitable by the District Engineer. Brush, roots, sod, any type of organic materials, and other perishable or unsuitable material as determined by the District Engineer shall not be placed in the embankment. Materials shall not be wasted except by specific instructions from the District Engineer.

b. Borrow. - Other suitable materials shall be borrowed from locations shown on the drawings in accordance with Paragraph 3-05. The origin of any material from either structure or borrow excavation does not definitely determine where it will be used in the embankment. Materials from two or more sources may be required to be used at the same time and in the same part of the embankment, mixing being done in the process of placing by systematic dumping, spreading and bulldozing. Materials from one area may be required to be used in different parts of the embankment.

c. Test requirements. - The various types of earth fill defined in Paragraph 5-01 shall conform to the test requirements and approved classification established by the Soils Laboratory, U. S. Engineer Office, Providence, R. I. The Area Engineer shall furnish the necessary labor and facilities for taking test samples which will be removed from the embankment by representatives of the District Engineer and subjected to field tests or boxed for shipment to the Soils Laboratory. Test samples will be taken at such intervals as will give, in the opinion of the District Engineer, a comprehensive knowledge of the material and its placement and compaction in each section of the embankment.

5-04. Plowing. - Immediately prior to the placing of materials in the embankment, and after stripping has been completed (see Paragraph 3-03), the entire foundation of the embankment shall be thoroughly plowed and broken to a depth of 4 inches. The furrows shall run approximately parallel to the axis of the embankment. All roots, stones, and debris

or other objectionable material shall be removed and disposed of as directed by the District Engineer. The condition of the surface material of the foundation area at the time of plowing shall be slightly drier than the required moisture content for rolled fill. The requirements for plowing do not apply to the side slopes of the cut-off and toe trenches, the old brook channel side slopes, and stump holes. After plowing, the entire surface of the foundation area shall be rolled in accordance with Paragraph 5-06 d.

5-05. Filling of excavations and old brook channel in embankment area. - a. General. - The old brook channel and the cut-off trench, test pits, stump holes and other excavated areas within the limits of the embankment and as otherwise shown on the drawings shall be filled with random or impervious materials in the dry as directed by the District Engineer. The fill shall be placed in layers, moistened, and rolled in accordance with Paragraph 5-06, whenever, in the opinion of the District Engineer, it is possible to do so. Material which cannot be compacted by roller equipment on account of clearances, shall be spread in 4-inch layers and compacted with hand or power tampers which shall give the degree of compaction required for the embankment. As the fill is brought up, the side slopes of the cut or hole shall be scarified by equipment or by hand if necessary to provide a bond between the fill and the original ground material (see Paragraph 5-06 d (2)).

b. Stump holes. - The sides of stump holes shall be broken down with bulldozers or a disc harrow so as to flatten out the slopes, and the hole then filled with approved material and properly rolled or tamped in place.

c. Cut-off trench. - The fill for the cut-off trench shall be placed in the dry and rolled in accordance with Paragraph 5-06. The water shall be drained to a sump and removed by pumps. The fill shall be made by working the materials toward the sump and sloping the surface of the fill longitudinally toward the sump. Well points may be used for drying up the foundation when approved by the District Engineer.

5-06. Rolled fill. - a. General. - The impervious and random sections of the embankment shall be constructed with a crown running with the center line of the dikes and with slopes approximately on a 2 percent grade toward the edges of the embankment. This slope shall be maintained until the completion of the embankment, thus bringing up together the impervious and random sections, unless otherwise directed by the District Engineer. As soon as practicable, the embankment shall be brought to a nearly uniform grade for the entire length. Subject to the approval of the District Engineer, the embankment construction shall proceed in sections of convenient length, and each section shall be carefully bonded to the preceding section.

b. Furnishing and placing. - (1) The Area Engineer may use power shovels, draglines, or any type of excavating machinery which is capable of excavating the materials in a dry condition. The

District Engineer will specify the location in the borrow areas and the depth to which excavation shall be made. The Area Engineer may use any approved method of transporting materials in natural dry condition to approved locations in the embankment. The dumping of the successive loads shall be at locations as directed or approved by the District Engineer. Sufficient excavating and hauling equipment shall be available so that not less than two sources of material can be worked at the same time. When two different materials are being moved into a section of the embankment, they shall be spotted and dumped systematically so that in any area of the section there are approximately the required proportions of the material. After dumping, the materials for the impervious section shall be bulldozed or otherwise spread in approximately 8-inch layers and rolled (see Paragraph 5-06 d). The random material shall be spread in approximately 12-inch layers and rolled (see Paragraph 5-06 d). Should the material for the various sections of the embankment be too high in water content when dumped, it shall be bulldozed or otherwise spread and harrowed or stirred and left for a sufficient time to allow the surplus water to dry out before being rolled. If, in the opinion of the District Engineer, the rolled surface of any layer of the materials is too smooth to bond properly with the succeeding layer or, if the materials have dried out sufficiently to cause cracks in the surface, it shall be roughened or loosened by a disc harrow, or other approved means, and dampened, if required, before the succeeding layer is placed thereon. All roots, trash, and debris shall be removed promptly from the embankment and disposed of to the satisfaction of the District Engineer. Stones greater than 6 inches in diameter shall be removed from the impervious and random sections and disposed of as directed by the District Engineer. The entire surface of the embankment shall be maintained in such condition that construction equipment can travel thereon. Routing of construction equipment on the embankment shall be subject to direction by the District Engineer.

(2) Any embankment material lost or loosened, after being placed in the embankment and before the completion and acceptance of the completed work, because of any operation of the Area Engineer or any causes that in the opinion of the District Engineer, were avoidable or under the control of the Area Engineer, shall be replaced to the satisfaction of the District Engineer and without additional credit. (see Paragraph 5-14 c).

(3) The Area Engineer shall cease work on the embankment at any time when satisfactory work cannot be done on account of rain, high water, cold weather, or other unsatisfactory conditions.

c. Moisture control. - To obtain the desired compaction for the varying kinds of materials used, the moisture content of the material being placed shall be the optimum required for satisfactory compaction as determined by the District Engineer. If required, the compacted surface shall be sprinkled as directed immediately before placing each new layer. The moisture content shall be sufficient to

dampen the filled materials as required, but the amount of sprinkling shall be controlled so that no free water will appear on the surface during or subsequent to the rolling. An adequate supply of water shall be available. Jets shall not be directed at the embankment material with such force that the finer materials are washed out.

d. Compaction. - (1) Tamper type roller. - Rolling for the impervious section of the embankment shall be done by a tamper type twin roller such as a "sheeps-foot" roller, water or sand ballasted, having tamping feet uniformly staggered over its cylindrical surface, and equipped with cleaners; or other satisfactory type of tamper roller as approved by the District Engineer. Each tamping foot shall project approximately 7 inches from the roller's cylindrical surface and shall have a face area of not less than 5 and not more than 7 square inches. The spacing shall be such as to provide a minimum of two tamping feet for each square foot of cylindrical surface. Addition or reduction in the number of tamping feet shall be made when directed by the District Engineer. The total weight of the roller in pounds divided by the total area of the maximum number of tamping feet in one row parallel to the axis of the roller shall be not less than 115 pounds per square inch tamping foot area with the drum empty, and not less than 200 pounds per square inch tamping foot area with the drum ballasted. The design and operation of the tamping roller shall be subject to the approval of the District Engineer.

(2) Rolling impervious section. - When the moisture content and condition of the spread impervious layers of the embankment are satisfactory to the District Engineer, the Area Engineer shall roll the impervious section of the embankment with tamper type twin rollers. Each set of twin rollers shall be pulled by a crawler type tractor of suitable power, weighing not less than 20,000 pounds, manufacturer's standard weight, at a speed of approximately 2-1/2 miles per hour. Each square foot of each layer of the embankment material shall be compacted by not less than six passes of the rollers. Additional passes of the rollers shall be made if necessary to obtain the compaction desired by the District Engineer. Successive trips of the rollers shall overlap by at least 2 feet. Failure to comply with this requirement for careful rolling will be a cause for additional trips. Where new material abuts old material, either in place or in embankment, the old material shall be cut or broken by machine or hand methods approved by the District Engineer, until it shows the characteristic colors of undried materials, and the rollers shall work on both materials, bonding them together. Portions of the earth fill which the roller cannot reach for any reason shall be thoroughly compacted in 4-inch layers by tamping with hand or power tampers. The degree of compaction for such portions of the earth fill shall be equivalent to that obtained by sprinkling and rolling as specified for the other portions of the earth fill.

(3) Rolling random section. - Rolling of the random section of the embankment shall be the same as specified above except that a minimum of 3 passes of the rollers will be required. If, in the opinion

of the District Engineer, better compaction can be obtained by the use of a plain cylindrical roller, or a Parson's disc tamping roller, the use of such a roller may be required. The disc tamping roller shall weigh not less than 1,100 pounds per linear foot. When conditions of the work so require, as determined by the District Engineer, rolling may be done by a crawler type tractor weighing not less than 20,000 pounds; in such cases a minimum of four passes of the tractor treads on each square foot of embankment area will be required.

(4) Tests for compaction. - Samples of all embankment materials for testing, both before and after placing and compaction will be taken at frequent intervals by the District Engineer. Corrections, adjustments and modifications of methods, selection of materials and moisture content will be made from these tests to secure the maximum density of the materials in the embankment (see Paragraph 5-03 c).

c. Impervious fill. - Impervious fill shall be selected and secured from required excavations and borrow areas as directed by the District Engineer and shall be placed in the impervious section of the embankment throughout the entire length.

f. Random fill. - Random fill shall be secured from required excavations and borrow areas as directed by the District Engineer, and shall be placed in the random sections of the embankment. In general this material shall be placed so the coarser portions are toward the landside edge, and the finer portions near the selected impervious section, so that a gradational transition is effected from the impervious to the random section.

5-07. Removal of objectionable material. - The Area Engineer shall excavate, remove and dispose of any material from the embankment sections, which the District Engineer considers objectionable in such locations, and refill the area as directed in accordance with Paragraph 5-05.

5-08. Slides. - In case of slides in any part of the embankment during the construction or after completion, but prior to the final acceptance of the work, the Area Engineer shall cut out and remove the area specified by the District Engineer and then rebuild the excavated area in accordance with these specifications.

5-09. Frozen materials. - No earth shall be placed upon a frozen surface, nor shall frozen earth, snow or ice be placed in the embankment. In cases of emergency, the District Engineer may require frozen material to be stockpiled for later use in the embankment.

5-10. Shrinkage or settlement. - No measurement will be made of additional material placed on account of settlement of the foundation or shrinkage during construction. The cost of placing and compacting such additional material shall be included in the various items of the

fill. Measurement and credit of all required fill material excavated and transported to point of placement will be in accordance with Section III.

5-11. Temporary drains and ditches. - The Area Engineer shall maintain the site of the work and the grounds immediately adjacent thereto, free from collected surface water, if, in the opinion of the District Engineer, such collected water affects the safety or condition of the work. Such temporary drains and ditches shall be constructed as are deemed necessary and directed by the District Engineer.

5-12. Topsoil and sodding. - a. Placing topsoil. - Unless otherwise authorized by the District Engineer, a suitable topsoil shall be placed on the slopes of the earth dikes as shown on the drawings. Credit for placing topsoil will be made under Item 24 (see Paragraph 11-02).

b. The areas upon which topsoil has been placed shall be sodded or seeded as specified in Paragraph 11-02. Measurement and credit will be made as specified in Paragraph 11-02.

5-13. Surfacing for top of dike. - Unless otherwise directed by the District Engineer, the top of the dikes shall be surfaced with a layer of gravel as shown on the drawings. Credit for placing the gravel surfacing will be made under Item 26 (see Paragraph 11-03).

5-14. Measurement and credit. - a. The quantities to be credited under Items 9 and 10 will be the number of cubic yards placed as directed, measured in place after compacting. Credit shall include the work of preparing the base, spreading in layers, wetting, rolling or tamping, trimming to line, and shall include all labor and materials incidental to completing the embankment, not specifically included under other items. Credit will be made under Items 9 and 10 as applicable (see Paragraph 1-07).

b. To determine the quantities for which credit will be made, a survey will be conducted prior to the beginning of the work. The true surface condition will be shown by cross sections and profile and the measurement of the quantities will be based upon this survey. The quantities will be the volume between the original surface at the beginning of the work and the slope lines and grades as indicated on the drawings, or as directed by the District Engineer.

c. Additional credit will be made to replace embankment washed out by flooding or scouring, or that required to be removed on account of slides, or the removal and disposal of all objectionable materials; provided such replacement of embankment was not caused by negligence or carelessness of the Area Engineer. Quantities for additional credit will be measured as directed by the District Engineer, and credit will be made under the applicable item.

SECTION VI. MISCELLANEOUS FILL AND BACKFILL (Items 11 and 12)

6-01. General. - "Gravel bedding," Item 11, will be required immediately underlying the riprap as shown on the drawings and for filters. "Semi-compacted backfill," Item 12, is required for backfill at the stop-log structure and other structures as shown on the drawings.

6-02. Gravel bedding (Item 11). - a. Work included. - The Area Engineer shall place a layer of gravel or crushed stone upon which riprap will be placed at the locations shown on the drawings and as directed by the District Engineer. The Area Engineer shall also place a layer of gravel or crushed stone of the specified quality required for drains at the locations shown on the drawings or as directed by the District Engineer.

b. Materials. (1) Gravel bedding shall consist of suitable coarse clean gravel satisfactorily graded within the specified limits and unless otherwise directed, not more than ten percent by weight shall pass a sieve having 10 meshes to the inch, and all shall pass a 2-inch square mesh screen. The material shall be obtained from sources approved by the District Engineer, be screened and placed directly in position.

(2) Crushed stone shall consist of angular fragments of uniform quality throughout, free from soft or disintegrated stone, dirt or other objectionable matter. The stone shall be uniformly graded within the specified limits. Unless otherwise directed, not more than 10 percent by weight shall pass a No. 4 sieve, and all shall pass a 2-inch square mesh screen. The material shall be obtained from sources approved by the District Engineer, be screened, and placed directly in position.

c. Placing. - The material shall be placed as shown on the drawings or as directed, and with such hand-placing as may be necessary to trim to the required slopes. The Area Engineer will not be required to tamp or roll the material, but shall consolidate it with water to the extent directed so that no settlement will later result.

d. Measurement and credit. - The quantity to be credited under Item 11 will be the number of cubic yards furnished and placed to the limits shown on the drawings, or ordered. Credit will be made under Item 11, "Gravel Bedding."

6-03. Semi-compacted backfill (Item 12). - a. Work included. - The Area Engineer shall place, grade, and consolidate materials required for backfill of the concrete structures, and elsewhere as directed.

b. Materials. - Materials shall be obtained from stockpiles of excavated materials (see Paragraph 3-01 b), or may be obtained directly from required excavations. Backfill material shall be free from stumps, roots, sod, rubbish, or other unsuitable materials or substances.

c. Placing. - The backfills shall consist of materials suitable for the purpose as determined by the District Engineer, and shall be placed in successive layers of not more than 12 inches in depth for the full width of the cross section. Each layer shall be consolidated with water or otherwise compacted to the extent directed so that no settlement or voids will later result. The backfill adjacent to concrete structures shall be thoroughly compacted in 4-inch layers by tamping with hand or power tampers unless otherwise directed by the District Engineer.

d. Measurement and credit. - Measurement will be made by the cubic yard for the amount of semi-compacted backfill placed in the completed work to the lines and grades shown on the drawings or as directed by the District Engineer. Quantities will be measured in place after any settlement. Credit for all work in connection with furnishing and placing semi-compacted backfill will be made under Item 12, "Semi-compacted Backfill".

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SECTION VII. RIPRAP AND DRAINS (Items 13 to 15 incl.)

7-01. General. - "Riprap - Hand Placed", Item 13, will be required for paving of the brook-side slope of the dike and the bank of the relocated channel, as shown on the drawings or as required by the District Engineer. "8-inch Porous Concrete Pipe", Item 14, will be required for drains where shown on the drawings or as required by the District Engineer. "8-inch V.C. Pipe", (Item 15), will be required for connecting existing tile pipe to manholes where shown on the drawings or as required by the District Engineer.

7-02. Riprap - Hand Placed (Item 13). - a. Work included. - The Area Engineer shall furnish all materials, equipment and labor required to construct hand-placed riprap to the lines and grades shown on the drawings, and elsewhere as required by the District Engineer.

b. Materials. - Riprap shall be of durable rock of acceptable sizes, with a specific gravity of not less than 2.65. Suitable rock from a source approved by the District Engineer shall be used. Rock for riprap shall be angular and of uniform shape so as to furnish a reasonably smooth, even surface. Not more than 5 percent by weight of the rock shall be smaller than one-half cubic foot in volume and at least 75 percent of the rock used shall be from 1 to 2 cubic feet in volume with one dimension approximately equal to the depth of the riprap course.

c. Placing. - The riprap shall be laid to the lines and grades shown on the drawings or as directed. A tolerance of 3 inches above or below the slope line shown on the drawings will be allowed for the finished slope surface of the hand-placed riprap. The rock shall be closely laid on a base of gravel bedding (see Paragraph 6-02), with the dimension approximately equal to the depth of the riprap course normal to the slope, and with joints broken where possible. The joints on the surface of the riprap shall be filled with tightly driven spalls. Large rock shall be well bedded at the edges of the riprap to prevent undermining.

d. Measurement and credit. - The quantity to be credited under Item 13 will be the number of cubic yards of riprap satisfactorily placed in the completed work to the specified or ordered lines and grades. Credit shall include all costs for furnishing, hauling and placing the riprap. Credit will be made under Item 13, "Riprap - Hand Placed".

7-03. 8-Inch porous concrete pipe (Item 14). - a. Work included. - The Area Engineer shall furnish and lay 8-inch porous concrete pipe required for drains at the locations shown on the drawings and elsewhere as required by the District Engineer.

b. Materials. - Pipe shall be porous concrete drain pipe, round in shape and of the normal inside diameter as shown on the drawings. Pipe shall have a laying length of 36 inches unless otherwise

shown on the drawings and a wall thickness of 1-1/4 inches. Pipe shall conform to the A.S.T.M. strength specifications for drain tile and shall have a minimum permeability per 12-inch length of 2-1/2 gallons per minute per inch of pipe diameter. All pipes shall be marked with the name and trade mark of the manufacturer. Each pipe shall be carefully inspected immediately before laying and no cracked, broken or otherwise imperfect pipe shall be used, except for minor defects which in the opinion of the District Engineer do not impair the fitness of the pipe for the purpose intended. Joints shall be of the interlocking or shiplap type.

c. Installation of pipe. - (1) Excavation. - Excavation shall be done as shown on the drawings and as provided for in Paragraph 3-04. Pipe trenches shall have a depth of not less than 2 feet with vertical sides and a width 2 feet greater than the outside diameter of the pipe, unless otherwise directed. The bottom of the trench throughout its length shall be carefully formed to fit the circular shape of the pipe except as otherwise shown on the drawings, so that the pipe shall be firmly supported on the bottom and for at least 3 inches up each side. Where encountered, rock or boulders shall be removed to a depth of 6 inches below the bottom grade of the trench and the voids backfilled with well compacted suitable material. Suitable excavations shall be made to fit all junctions or other specials wherever needed. Joints in pipe shall be located as shown on the drawings, with relation to adjacent structures.

(2) Laying pipe. - All pipe shall be placed in the trench immediately after the excavation is completed and the screened gravel has been placed and compacted to form a bed as indicated on the drawings. Proper care shall be used in handling the pipe to avoid injury or breakage. The pipe shall be carefully bedded, and properly connected and jointed. The pipes shall be laid true to the lines and grades shown on the drawings or as staked in the field with grooves upgrade and with tongue ends fully entered in the grooves. Where connections are made to bell-and-spigot tile pipes, the joint shall be tight and the alignment assured by a concrete ring or other means approved by the District Engineer.

(3) Backfilling. - The backfill material as shown on the drawings shall be evenly spread and compacted around and over the the pipe to the limits shown on the drawings or as directed by the District Engineer.

d. Measurement and credit. - (1) Measurement for credit will be based on the linear feet of pipe installed. Credit will be made under Item 14, "8-Inch Porous Concrete Pipe", and shall include all cost of furnishing and installing pipe and connections, except the cost of excavation and backfilling.

(2) Credit for excavation will be made under Item 3 (see Paragraph 3-04). Credit for backfilling will be made under Item 11 (see Paragraph 6-02 d).

7-04. 8-inch V.C. pipe. - (Item 15). - a. Work included. - The Area Engineer shall furnish and lay tile pipe, including specials, of the required diameter for connecting existing tile pipe to manholes as shown on the drawings.

b. Materials. - All pipes shall be bell-end-spigot, vitrified, clay pipe conforming to the requirements of Federal Specification SS-P-361, or subsequent amendments or revisions thereof. Each pipe shall be carefully inspected immediately before laying and no cracked, broken or otherwise imperfect pipe shall be used, except for minor defects which in the opinion of the District Engineer do not impair the fitness of the pipe for the purpose intended.

c. Installation of pipe. - (1) Excavation. - Excavation shall be done as shown on the drawings and as provided for in Paragraph 3-04. Pipe trenches shall have a depth of not less than 2 feet with vertical sides and a width 2 feet greater than the outside diameter of the pipe, unless otherwise directed. The bottom of the trench throughout its length shall be carefully formed to fit the circular shape of the pipe except as otherwise shown on the drawings, so that the pipe shall be firmly supported on the bottom and for at least 3 inches up each side. Where encountered, rock or boulders shall be removed to a depth of 6 inches below the bottom grade of the trench and the voids backfilled with well compacted suitable material. Suitable excavations shall be made to fit all junctions or other specials wherever needed. Joints in pipe shall be located as shown on the drawings, with relation to adjacent structures.

(2) Laying pipe. - All pipe shall be placed in the trench immediately after the excavation is completed. Proper care shall be used in handling the pipe to avoid injury or breakage. The pipe shall be carefully bedded, and properly connected and jointed. Bell holes shall be excavated to insure that each pipe shall rest firmly upon its bed for the entire pipe length. The pipes shall be laid true to the lines and grades shown on the drawings or as staked in the field, with bells upgrade and with spigot ends fully entered in the bells. Joints shall be made with cement mortar composed of one part Portland cement and 2-1/2 parts sand. All mortar used shall be thoroughly mixed either by hand or in a mechanical batch mixer. Mortar shall be prepared in such quantities that it can be used entirely before it has attained its initial set. The minimum amount of water sufficient to make a workable mortar shall be used. Cement and sand used in mortar shall meet the requirements of Paragraphs 8-05 and 8-06. The spigots shall be centered in the bells, and there shall be no shoulders or unevenness of any kind along the bottom half of the pipes. Special care shall be taken that the joint space be of equal width around the pipe, making use of jute or oakum gaskets soaked in cement grout to center the pipe. The mortar shall be thoroughly

SECTION VIII. CONCRETE (Items 16 to 20 incl.)

COMPOSITION, CLASSIFICATION AND STRENGTH

8-01. Composition. - Concrete shall be composed of cement, fine aggregate, coarse aggregate and water so proportioned and mixed as to produce a plastic, workable mixture in accordance with all requirements under this section and suitable to the specific conditions of placement.

8-02. Classification. - Except where required to meet special conditions all concrete shall be Class "A" as designated in Sections IX and XI and on the drawings for the various parts of the work in accordance with the conditions of application and the proportions of materials and strengths required.

8-03. Strength. - The mixes will be designed to secure concrete having at least the following compressive strengths at the age of 28 days, as determined by breaking standard 6-inch diameter by 12-inch height or 8-inch diameter by 16-inch height test specimens:

Class	Average for any 25 consecutive cylinders	Minimum for any one cylinder
A	3400 lbs. per sq. in.	2600 lbs. per sq. in.

8-04. High-early-strength concrete. - High-early-strength concrete made with high-early-strength Portland cement or other special cements shall be used only when specifically authorized by the District Engineer. The 7-day compressive strength of concrete of any class, when made with high-early-strength cement, shall be at least equal to the specified minimum 28-day compressive strength for that class. All provisions of these specifications, except for cement, shall be applicable to such concrete. Any high-early-strength cement used shall be approved by the District Engineer before use.

MATERIALS

8-05. Portland cement (Item 16). - a. The Area Engineer shall furnish Portland cement of the quality herein specified in sufficient quantity for the work required. Cement for all concrete, grout and mortar, except as specified in Paragraph b, shall conform to Federal Specification SS-C-206, for "Cement, Portland, Moderate-Heat-of-Hardening, September 30, 1936", except that Paragraph E-7, Heat of Hydration, will be considered inoperative.

b. High-early-strength Portland cement. - Cement for high-early-strength concrete shall be in accordance with Federal Specification SS-C-201 for "Cement, Portland, High-Early-Strength."

c. Special test requirements. - Cement will be tested by the Government at the Central Concrete Laboratory, West Point, N. Y. No cement shall be used until notice has been given by the District Engineer that the test results are satisfactory. Cement which has been stored, other than in bins at the mills, for more than 4 months after being tested shall be retested before use. Ordinarily, no cement shall be used until after it has satisfactorily passed both the 7 and 28-day tests, but in cases of emergency the District Engineer may waive the 28-day tests and permit the use of cement which has satisfactorily passed the soundness and 7-day tests; provided it is the product of a quarry and mill having established a reputation of not less than 3 years' standing for the production of high-grade cement. If the tests prove any cement unsatisfactory which has been delivered at the site of the work, such cement shall be removed promptly from the work and its vicinity.

d. Identification. - Cement shipped in bags shall be identified by the manufacturer by marking or tagging the bags with the identifying number or symbol of the Federal Specifications under which it was manufactured. Bulk shipments of cement shall be likewise identified by a suitable device affixed to each car or other type of bulk carrier. Marking or tagging shall be done at the mill.

e. Quality and packages. - All cement shall be dry, finely ground and free from lumps or caking. Unless otherwise permitted, the cement shall be delivered in canvas bags or other strong, well-made packages, each plainly marked with the manufacturer's brand. The weights of such bags shall be uniform. Packages received in broken or damaged condition will be rejected or accepted only as fractional packages. Cement shall be stored in a satisfactory manner so as to be unaffected by moisture, keeping each carload separate until the results of the 28-day tests are known. Suitable accurate scales shall be provided by the Area Engineer for weighing the cement.

f. Records of cement used. - The Area Engineer shall furnish to the District Engineer, at the end of each day's work, a statement showing in such detail as he may reasonably require the quantity of cement used during the day at each part of the work.

8-06. Fine aggregate. - a. Composition. - Fine aggregate shall be natural sand.

b. Quality. - Fine aggregate shall consist of hard, strong, durable and uncoated particles.

c. Grading. - (1) Except as provided in (2) below, fine aggregate shall conform to the following requirements:

Total passing -	Percent by weight
No. 4 sieve	95 - 100
No. 16 sieve	45 - 75
No. 50 sieve	10 - 25
No. 100 sieve	1.5 to 7

(2) Deficiencies in the percentages of fine aggregate passing #50 and #100 sieves, as required in the above gradation, may be remedied by the addition of pozzuolanic or cementitious materials, excepting Portland cement; provided, at least 5 percent passes the #50 sieve and the aggregate is of proper consistent gradation within the specified limits. Such added material, which will be considered and included as fine aggregate, shall conform to the requirements in Paragraph 8-08 and shall be in sufficient quantity to meet the minimum requirements above for percentage passing #100 sieve and otherwise to produce the workability required by the District Engineer. The quantity and characteristics of any material used for the purpose of correcting workability shall be such that when the concrete is gaged to the proper consistency, the total water content shall not exceed by more than 1 gallon per cubic yard the minimum quantity required for proper consistency when not using the admixture. The blending of any material with the original naturally graded sand to remedy deficiency in gradation shall be accomplished in charging the mixture, unless otherwise specifically authorized by the District Engineer.

d. Deleterious substances. - The substances designated shall not be present in excess of the following amounts:

	Percent by weight
Clay lumps	1
Material removed by decantation from aggregates	3
Shale	0.5

e. Mortar strength. - Mortar specimens made with the fine aggregate shall have a compressive strength at 28 days of at least 90 percent of the strength of similar specimens made with Ottawa sand having a fineness modulus of 2.40± 0.10 and the same cement.

f. Tests. - Fine aggregate shall be subject to careful, thorough analyses, including magnesium sulphate soundness tests (see Paragraph 3-07 d), to determine conformity with all requirements of these specifications.

8-07. Coarse aggregate. - a. Composition. - Coarse aggregate shall be washed gravel, crushed stone or any approved mixture of washed gravel and crushed stone.

b. Quality. - (1) Coarse aggregate shall consist of hard, tough and durable particles free from adherent coating. It shall contain no vegetable matter, soft or friable particles in quantities considered deleterious by the District Engineer. The substances designated shall not be present in excess of the following amounts (by weight):

Soft fragments	5%
Clay lumps	1/4%
Removed by decantation	1%

When the material removed by decantation consists essentially of crusher dirt, the maximum amount permitted may be raised by 1-1/2 percent. When crushed stone is used, the crusher shall be equipped with a screening system which will entirely separate the dust from the stone and convey it to a separate bin.

(2) Aggregate which has disintegrated or weathered badly under exposure conditions similar to those which will be encountered by the work under consideration shall not be used. Aggregate shall not be used which contains more than 20 percent by weight of thin and elongated particles as defined below:

Thin particles - Those whose average thickness (minimum diameter) is less than 1/5 their length (maximum diameter).

Elongated particles - Those whose average width (secondary diameter) is less than 1/3 their length (maximum diameter).

The 20 percent limitation on thin and elongated particles shall apply to each of three size ranges; #4 to 1/2 inch; 1/2 inch to 1 inch; 1 inch to maximum size (see Paragraph 8-07 d(2)).

c. Size. - (1) Coarse aggregate shall be well graded from fine to coarse so that concrete of the required workability, density, and strength can be made without the use of an excess amount of sand, water, or cement.

For Class "A" concrete, required for Items 17, 18, and 19 the maximum size mesh screen for the aggregate shall be 2 inches.

(2) When the maximum size mesh screen is greater than 1 inch, the aggregate shall be separated, and the specified sizes delivered separately to individual proportioning hoppers, in accordance with the following:

For Maximum Size Mesh Screen, 1 in. to 2 in. inclusive:

(1) No. 4 to 1/2 maximum size mesh screen, inclusive.
(2) Over 1/2 maximum size to and including full maximum size mesh screen.

(3) The grading of the coarse aggregate, in the mixed concrete, shall fall within the following limits:

	(Percent by weight) Passing
Maximum size mesh screen (square mesh)	97 - 100
1/2 maximum size mesh screen (square mesh)	40 - 70
No. 4 sieve	0 - 6

d. Tests. - (1) Coarse aggregate will be subjected to freezing and thawing tests and to careful, thorough analyses to determine conformity with all requirements of these specifications. Coarse aggregate will be subjected to 10 cycles of the magnesium sulphate test for soundness. No aggregate shall be used which develops a loss in excess of 10 percent by weight.

(2) The determination of thin and elongated particles will be made by counting rejects from representative samples (see Paragraph 8-11). The size of the sample shall be not less than:

5 pounds for the #4 to 1/2-inch size range.
10 pounds for the 1/2-inch to 1-inch size range.
20 pounds for the 1-inch to maximum size range.

Of those particles which appear in a border-line classification, neither unquestionably suitable nor unquestionably unsuitable, one-half shall be counted as rejects and one-half as suitable for use. The percentage of total rejects from each sample shall then be determined.

8-08. Material added for workability. - a. The use of any material added to the mix to improve workability (see Paragraph 8-06 c(2)), which, in the opinion of the District Engineer, may have an injurious effect on the strength, density, and durability of the concrete, will not be permitted. Before approval of any material, the Area Engineer will be required to submit the results of complete chemical and sieve analyses made by an acceptable testing laboratory. Subsequent tests will be made of samples taken by the District Engineer from the supply of the material being used on the work to determine whether it is uniform in quality with that approved.

b. The material added shall be pozzuolanic, cementitious or silicious. It shall not contain effective early-heat-producing elements nor compounds, such as those contained in Portland cement, nor shall its use result in a material increase in the free-lime content of the concrete. It shall also be in conformity with the following requirements:

Free moisture - a total of not more than 3 percent by weight.
Passing #30 sieve - not less than 100 percent by weight.
Passing #200 sieve - not less than 85 percent by weight.

8-09. Water. - The water used in mixing concrete shall be fresh, clean and free from injurious amounts of oil, acid, alkali, or organic matter.

8-10. Storage. - a. Cement. - Immediately upon receipt, at the site of the work, cement shall be stored in a thoroughly dry, weather-tight, and properly ventilated building with adequate provisions for the prevention of the absorption of moisture. The building shall be of adequate capacity to provide for the requirements of delivery and construction schedules. Storage shall be such as to permit easy access for inspection and definite identification of each shipment.

b. Aggregates. - The fine and coarse aggregates shall be stored separately (see Paragraph 8-07 c (2)) and in such manner as to avoid the inclusion of any foreign material in the concrete. Stock-piles of coarse aggregates shall be built in horizontal layers to avoid segregation.

8-11. Sampling and testing aggregates. - Except where provided otherwise by these specifications, all sampling and testing of aggregates shall be made in accordance with the Federal Specifications. Unless specified otherwise, all test samples shall be taken under the supervision of the District Engineer and supplied to the Central Concrete Laboratory, est Point, N. Y., by the dealer at his expense. The source from which concrete aggregates are to be obtained shall be selected by the Area Engineer well in advance of the time when they will be required in the work, and suitable samples as they are to be used in the concrete shall be furnished to the District Engineer at least 30 days in advance of the time when the placing of the concrete is expected to begin. The Area Engineer shall obtain fine and coarse aggregates for concrete from sources approved by the District Engineer.

PROPORTIONING, MIXING AND PLACING

8-12. Proportioning. - a. Basis. - All concrete materials will be proportioned so as to produce a workable mixture in which the water content will not exceed the maximum specified.

b. Control. - The exact proportions of all materials entering into the concrete shall be as directed by the District Engineer. The Area Engineer shall provide all equipment necessary to positively determine and control the actual amounts of all materials entering into the concrete. The proportions will be changed whenever, in the opinion of the District Engineer, such change becomes necessary to obtain the specified strength and the desired density, uniformity and workability, and the work will not receive additional credit because of such changes.

c. Measurement. - All materials shall be measured by weight except that water may be measured by volume when so authorized by the District Engineer. One bag of cement will be considered as 94 pounds in weight and 1 gallon of water as 8.33 pounds.

d. Cement content. - Each cubic yard of concrete shall contain not less than 5.0 bags or 470 pounds of cement. For concrete deposited in water the minimum cement content shall be 6.5 bags or 611 pounds to each cubic yard of concrete in place.

e. Water content. - (1) In calculating the total water content in any mix, the amount of moisture carried on the surface of the aggregate particles shall be included. The total water content for a bag of cement for each batch of concrete shall not exceed 6.0 gallons or 50.0 pounds. In all cases, however, the amount of water to be used shall be the minimum amount necessary to produce a plastic mixture of the strength specified and of the desired density, uniformity and workability. In general, the consistency of any mix shall be that required for the specific placing conditions and methods of placement, and ordinarily the slump shall be between 1 inch and 3 inches when tested in accordance with the current specifications for "Method of Test for Consistency of Portland Cement Concrete," of the American Society for Testing Materials.

(2) An increase in the maximum water content, based only on the requirements of materials added in accordance with Paragraph 8-06 c to improve workability will not be permitted unless comparative tests under job conditions show conclusively that such increase in water content will not result in a decrease in concrete strength and provided further that such increase does not exceed 1 gallon per cubic yard.

f. Aggregate content. - The total volume of aggregates to be used in each cubic yard of concrete shall be that necessary to produce a dense mixture of the required workability as determined by the District Engineer.

8-13. Mixing and placing. - a. Equipment. - Concrete shall be mixed in approved mechanical mixers of a rotating drum type, except that if permitted relatively small quantities may be mixed by hand in a satisfactory manner. Concrete shall be mixed at all times by competent and experienced men. The Area Engineer shall provide at the site of the work a modern and dependable batch type mixing plant with a minimum capacity of 100 cubic yards of concrete per 8 hours, or if approved by the District Engineer, the Area Engineer may use standard truck mixing equipment of approved capacity. The equipment shall provide adequate facilities for the accurate measurement and control of each of the materials entering the concrete. The complete plant assembly, including provisions to facilitate the inspection of all operations at all times and the adequacy and dependability of each of its parts shall be subject to the approval of the District Engineer and shall conform to the following requirements:

(1) It shall be capable of ready adjustment for compensating for the varying moisture content of the aggregates and for changing the proportionate batch weights.

(2) It shall be capable of controlling the delivery of all material within 1 percent by weight of the specified amounts.

(3) It shall be arranged to permit the convenient removal of the material in excess of the specified tolerances.

(4) It shall include a visible dial or any suitable device which will accurately register the scale load at any stage of the weighing operations from zero to full capacity.

(5) The accuracy of the weighing equipment shall conform to the requirements of the U. S. Bureau of Standards and shall be tested monthly or otherwise when required without expense to the Government.

(6) It shall include a device for accurately measuring and indicating the quantity of water entering the concrete, and the operating mechanisms must be such that no leakage will occur when the valves are closed.

(7) It shall include a device for accurately and automatically measuring and indicating the time required for mixing and which may be interlocked to prevent the discharge of concrete from the mixer before the end of the mixing period.

(8) It shall include a device for properly recording and indicating the number of batches handled.

b. Time. - The minimum time for mixing each batch, after all materials are in the mixer, shall be as follows:

1/2 to 1-1/2 cu. yd. mixer	1-1/2 minutes
Larger than 1-1/2 cu. yd. mixer	2 minutes

The mixer shall revolve a minimum of 12 revolutions after all materials have been placed in it, and at a uniform speed. Neither speed nor volume capacity of the mixer shall exceed those recommended by the manufacturer. Excessive overmixing, requiring additions of water to preserve the required consistency, will not be permitted.

c. Conveying. - Concrete shall be conveyed from mixer to forms as rapidly as practicable, by methods which will prevent segregation or loss of ingredients. It shall be deposited as nearly as practicable in its final position. Conveying of concrete by means of chutes will not be permitted except for short chutes in the forms to distribute the concrete. Chutes used shall be such that the concrete slides in them and does not flow. Chutes with a flatter slope than 1 on 2 will not be permitted. There shall be no free vertical drop greater than 5 feet except where specifically authorized by the District Engineer.

d. Placing. - (1) Concrete shall be placed before initial set has occurred, and in no event after it has contained its water content for more than 45 minutes.

(2) Unless otherwise specified, all concrete shall be placed in the dry upon clean, damp surfaces, free from ice, frost or running water, and never upon soft mud, dry porous earth, or upon fills that have not been subjected to approved rolling, puddling or tamping so that ultimate settlement has occurred.

(3) Rock surfaces upon which concrete is placed shall be approximately horizontal or stepped, rough, and free from loose material or other matter interfering with a satisfactory bond. The rock shall be washed, scrubbed with steel brushes or brooms, and spread with a layer of mortar about 1/2 inch thick, immediately before the concrete is placed. The mortar shall be of the same cement-sand ratio as used in the concrete.

(4) Unless otherwise specifically authorized or directed, concrete in mass structures shall be placed in monoliths not exceeding 40 feet in length or width. The layout of all monoliths shall be as directed or approved by the District Engineer before concreting is commenced.

(5) All concrete shall be deposited in approximately horizontal layers not to exceed 24 inches in thickness unless otherwise specifically authorized or directed by the District Engineer and the concreting shall be carried on as a continuous operation, as far as practicable, until the placing in the course, section, panel or monolith is completed. Unless otherwise shown on the drawings, courses shall generally have a minimum thickness of 4 feet, and a maximum of 18 feet, except that in hot weather the District Engineer may direct the maximum be reduced to 8 feet. A minimum time interval of 48 hours shall be allowed between successive courses for the dissipation of heat of hydration.

(6) In dropping concrete through reinforcement, care shall be taken that no segregation of the coarse aggregate occurs. On flat surfaces, where the congestion of steel near the forms makes placing difficult, a mortar of the same cement-sand ratio as is used in the concrete shall be first deposited to cover the forms.

(7) All top surfaces not covered by forms and which are not to be covered by additional concrete or backfill shall be carried slightly above grade and struck off by board screed (see Paragraph 8-15), except that top surfaces of walls and piers not covered by forms and which are not to be covered by additional concrete or backfill, when poured in excess of 10 feet in height in one pour, shall be carried not less than 2 inches above the specified finished elevation and struck off by board screed.

e. Vibrating. - Concrete shall be placed with the aid of mechanical vibrating equipment as approved by the District Engineer.

(1) Internal vibrators shall be used in all sections which are sufficiently large to accommodate them. External vibration shall be used for all reinforced concrete sections as auxiliary to internal vibration.

(2) Vibrators shall be of sturdy construction, adequately powered and capable of transmitting to the concrete not less than 5000 impulses per minute when operating under load (immersed in concrete). The frequency of vibration shall be subject to proof by measuring the impulses radiated by the vibrator, when operating in concrete designed for the project, by use of a Frahm vibrating-reed tachometer or equal. The vibration shall be sufficiently intense to cause the concrete to flow or settle readily into place and show a visible effect over a radius of at least 18 inches in the concrete designed for the project.

(3) A sufficient number of vibrators shall be employed so that, at the required rate of placement vibration throughout the entire volume of each layer of concrete and complete compaction are secured. At least one extra vibrator shall be constantly on hand at each point of placement (monolith) for emergency use.

(4) External vibrators shall be attached to or held on the forms in such a manner as to transmit the vibration to the concrete effectively and shall be raised in lifts as filling of the forms proceeds, each lift being not more than the height of concrete visibly affected by the vibration. They shall be placed horizontally at distances not greater apart than the radius through which the concrete is visibly affected.

(5) Internal vibrators shall be kept constantly moving in the concrete and shall be applied at points uniformly spaced not farther apart than the radius over which the vibrator is visibly effective. The vibrator shall not be held in one location long enough to draw a pool of grout from the surrounding concrete. Internal vibrators shall be applied close enough to the forms to vibrate the surface concrete effectively, but care shall be taken to avoid hitting the forms sufficiently to damage them.

(6) With external and internal vibrators, the vibration shall be such that the concrete becomes uniformly plastic and there shall be at least 20 seconds of vibration per square foot of surface of each layer of concrete, computed on the basis of the visibly affected radius, and taking overlapping into consideration.

(7) Vibration shall be supplemented by forking and spading by hand adjacent to the forms on exposed faces that cannot be effectively vibrated. The concrete shall be compacted and worked in an approved manner into all corners and angles of the forms and around reinforcement and embedded fixtures.

f. Construction joints. - Vertical joints shall be formed with tongue-and-groove bonds or keys at such locations and of such shapes and dimensions as approved or directed by the District Engineer. Horizontal joints shall be roughened level joints, true to line at the exposed concrete surfaces. Where required, dowel rods shall be used. All concrete in vertical members shall have been in place not less than 12 hours, and longer if so directed by the District Engineer, before concrete in horizontal members resting thereon is placed. As soon as practicable after placing and immediately before placing the succeeding layers is resumed, all approximately horizontal surfaces shall be washed with a high pressure air-and-water jet, or cleaned as otherwise directed by the District Engineer. Sand shall be added to the air-and-water jet when required, to remove alkali, algae, stains, and other substances injurious to the bond. The time and method of using the jet shall be such that all laitance, scum, etc. will be removed, so the partly embedded aggregate is not disturbed and is washed clean. After final cleaning and immediately before placing is resumed, the surfaces shall be wetted and spread with a layer of mortar 1/2 inch thick, thoroughly brushed in. The mortar shall be the same cement-sand ratio as the concrete.

g. Cold weather. - Concrete shall not be placed when the ambient atmospheric temperature is below 35 degrees F., nor when the concrete is likely to be subject to freezing temperatures before final set has occurred, unless specifically authorized by the District Engineer in writing. When so authorized, the materials shall be heated in order that the temperature of the concrete, when deposited, shall be not less than 50 degrees F. nor more than 70 degrees F. All methods and equipment for heating shall be subject to the approval of the District Engineer.

h. Hot weather. - For concrete placed during the extremely warm summer months and otherwise, when directed by the District Engineer, the aggregates shall be cooled by frequent spraying in such manner as to utilize the cooling effect of evaporation. During such periods the placement schedule shall be arranged as approved by the District Engineer in such manner as to provide time for the temperature of the previously placed course to begin to recede. The mixing water shall be the coolest available at the site insofar as is practicable.

8-14. Test specimens. - a. Number. - Test specimens, to determine whether the compressive strength of the concrete is in accordance with that specified in Paragraph 8-03, will be taken by the inspector. At least 1 set of 3 specimens will be made for every major pour and in general for every 100 cubic yards of concrete placed, but in any event, a sufficient number of specimens will be taken to give a comprehensive knowledge of the concrete placed during each day in each section of the work.

b. Method. - All specimens will be taken from the concrete at the mixing plant. The specimens will be tested by the Government at the Central Concrete Laboratory, West Point, N. Y. All costs of transportation and testing of specimens will be borne by the Government.

8-15. Finishing. - a. Immediately after placement, the concrete shall be properly forked back along the face of all forms by the use of standard concrete forks or spades unless otherwise specifically authorized or directed by the District Engineer. The finished surfaces shall be free from sand streaks or other voids and the plastering over of such surfaces will not be permitted. Defective concrete shall be repaired by cutting out the unsatisfactory material to a depth of not less than 2 inches, and placing new concrete which shall be formed with keys, dovetails or anchors to attach it securely to the other work. One anchor shall be placed for each 64 square inches of area and the sides of the cut areas shall be generally rectangular. This concrete shall be drier than the usual mixture and shall be thoroughly tamped into place behind forms securely fastened. Unless otherwise specified, all surfaces of concrete including sidewalk not covered by forms, that are not to be covered by additional concrete, or backfill, shall have a wood float finish without the addition of mortar, and shall be true to elevations as shown on the drawings. Care shall be taken to see that all excess water is removed before making this finish. Other surfaces shall be brought to the specified finished elevation and left true and regular as approved by the District Engineer. Where considered necessary by the District Engineer or where indicated on the drawings, joints shall be carefully made with a jointing tool. Every precaution shall be taken by the Area Engineer to protect finished surfaces from stains or abrasions. No fire shall be permitted in direct contact with any concrete at any time. Concrete surfaces or edges likely to be injured during the construction period, shall be properly protected by leaving the forms in place, or by erecting covers satisfactory to the District Engineer.

b. Immediately after the forms are removed, and without interfering with proper curing, all fins, form marks, and irregularities shall be removed and all voids and cavities shall be pointed with a stiff mortar of the same composition as the mortar in the concrete. All exposed surfaces of the concrete shall be brought to a smooth neat finish by rubbing with corundum brick and water except as otherwise provided. The use of mortar, grout, paint, or wash (except clear water) for finishing concrete will not be allowed. The finishing of concrete surfaces of structures shall be done by competent cement finishers and the work shall meet the approval of the District Engineer.

8-16. Curing. - a. Warm weather. - All concrete shall be adequately protected from injurious action by the sun. Fresh concrete shall be protected from heavy rains, flowing water, and mechanical injury. All concrete shall be kept wet for a period of not less than 14 days by covering with water, or with an approved water-saturated covering, or by a system of perforated pipes or mechanical sprinklers, or any other approved method which will keep all surfaces continuously (not periodically) wet. Where wood forms are left in place for curing, they shall be kept wet at all times to prevent opening at the joints and drying out of the concrete. Water for curing shall be generally clean and entirely free from any elements which in the opinion of the District Engineer might cause staining or discoloration of the concrete.

b. Cold weather. - Concrete when placed during cold weather shall be kept moist and provided with adequate protection for a period of not less than 14 days, subject to the approval of the District Engineer so that the air in contact with the concrete will be maintained at temperatures between 50 degrees F. and 70 degrees F. for at least the first 5 days of the curing period. For massive sections, where the atmospheric temperatures are sufficiently low in the opinion of the District Engineer to cause excessively rapid cooling and contraction of the exterior surfaces, this period for maintaining the temperature of the air in contact with the concrete between 50 and 70 degrees F. shall extend over the entire curing period. Salt or other chemicals shall not be admitted into the mixture to prevent freezing except with the approval of the District Engineer.

FORMS, REINFORCEMENT AND PAYMENT

8-17. Forms. - a. Materials. - Forms shall be of wood, steel or other approved material. The sheeting for all exposed surfaces shall be tongue-and-groove lumber of uniform width unless otherwise specifically authorized. Forms of like character shall be used for similarly exposed surfaces in order to produce a uniform appearance. The type, size, shape, quality and strength of all materials of which the forms are made shall be subject to the approval of the District Engineer.

b. Construction. - Forms shall be built true to line and grade, and shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports. Responsibility for their adequacy shall rest with the Area Engineer. Their surfaces shall be smooth and free from irregularities, dents, sags, or holes when used for permanently exposed faces. Bolts and rods used for internal ties shall be so arranged that, when the forms are removed, all metal will be not less than 2 inches from any concrete surfaces. Wire ties will not be permitted where the concrete surface will be exposed to weathering and discoloration will be objectionable. All forms shall be so constructed that they can be removed without hammering or prying against the concrete. Unless otherwise indicated, suitable moldings shall be placed to bevel or round exposed edges, at expansion joints or any other points as may be required by the District Engineer.

c. Coating. - Prior to the placing of steel reinforcement or concrete, forms for exposed surfaces shall be coated with a non-staining mineral oil. Forms for unexposed surfaces may be thoroughly wetted in lieu of oiling, immediately before the placing of concrete, except that in freezing weather oil shall be used.

d. Removal. - Forms shall not be removed without the approval of the District Engineer, and all removal shall be accomplished in such manner as will prevent injury to the concrete. Forms shall not be removed before the expiration of the minimum number of days indicated below, except when specifically authorized by the District Engineer. When, in the opinion of the District Engineer, conditions

on the work are such as to justify it, forms may be required to remain in place for longer periods.

Arches, beams and slabs	7 days
Columns	3 days
Walls and vertical faces	2 days

8-18. Furnishing, bending, and placing steel reinforcement (Item 20). a. Work included. - (1) The Area Engineer shall furnish, cut, bend and build into the concrete, in accordance with the drawings and directions, all reinforcing steel of deformed bars, dowels or anchors.

(2) Steel reinforcement may be cut and bent at the mill or in the field. All bending shall be in accordance with standard approved practice and by approved machine methods.

b. Materials. - (1) Steel reinforcement shall be of new billet intermediate grade, open-hearth steel, deformed, and shall conform to the Federal Specifications QQ-B-71a for "Bars, reinforcement, concrete, Type "B", Grade 2 (dated January 12, 1938)". Certified copies of any mill test required shall be furnished by the Area Engineer and the steel shall be subjected to such tests as the District Engineer may consider necessary to establish its quality, including particularly the requirements of bending and elongation. The steel shall be free from oil, paint, dirt or excessive rust.

(2) Expanded metal reinforcement may be used as an alternate for horizontal reinforcement only in walls. This reinforcement shall consist of a diamond shaped steel mesh manufactured from open-hearth steel, by a cold drawn process which will cut and draw the material, so that uniform strands are formed at regular intervals along the length of the sheet with the plate intact between successive strands. It shall possess ductile properties which will permit any strands to be bent through an angle of 180° over one diameter, without fracture, and to have a yield point of not less than 55,000 pounds per square inch. The size of the diamond shall be approximately 3 inches by 8 inches, and the effective cross-sectional area shall be not less than 0.30 square inches per foot of width, similar or equal to Style No. 3-9-30, as manufactured by The Consolidated Expanded Metal Companies, Wheeling, West Virginia.

(3) Wire mesh reinforcement for concrete pavement shall be as shown on the drawings and shall conform to A.S.T.M. Specifications A185-36T.

c. Placing. - (1) All steel reinforcement shall be placed in the exact positions and with the spacing shown on the drawings or ordered, and it shall be so fastened in position as to prevent its becoming displaced during the placing of the concrete. The clear distance between parallel rods shall be not less than one and one-half

times the diameter of round rods, or twice the side dimensions of square rods, and unless specifically authorized, shall in no case be less than 1 inch.

(2) Except where otherwise indicated, reinforcement shall be placed as follows:

(a) All main reinforcement shall be placed not less than 3 inches from any surface, except in slabs.

(b) All main reinforcement in walls and slabs exposed to the weather and in fire-resistant construction, shall be placed not less than 1 inch from the surface. The covering of stirrups, spacer rods, and similar secondary reinforcement may be reduced by the diameter of such rods. The above dimensions shall be measured from the face of the reinforcement to the face of the forms.

(c) Where splices in reinforcement, in addition to those indicated, are necessary, there shall be sufficient lap to transfer the stress by bond as may be directed. Rods shall be lapped not less than 40 diameters and splices shall be staggered. The lapped ends of rods shall be separated sufficiently or connected properly to develop the full strength of rod. Adjacent sheets of mesh reinforcement shall be spliced by lapping not less than 6 inches, the lapped ends being securely wired together.

d. Protection. - Steel reinforcement shall be new unrusted stock, free from loose scale. It shall be at all times satisfactorily protected from moisture until placed in final position. Ends of rods that are to be left projecting for a considerable time shall be protected from corrosion by heavy wrapping of burlap saturated with bituminous material.

8-19. Embedded items. - In addition to steel reinforcement, there shall be built into, or set, or attached to the concrete, pipes, sidewalk grating and cover, and other metal objects as shown on the drawings or ordered. All necessary precautions shall be taken to prevent these objects from being displaced, broken or deformed. Before placing concrete, care shall be taken to determine that any embedded metal or wood parts are firmly and securely fastened in place as indicated. They shall be thoroughly clean and free from paint or other coating, rust, scale, oil, or any foreign matter. The embedding of wood in concrete shall be avoided whenever possible, metal being used instead. The concrete shall be packed tightly around pipes and other metal work so as to prevent leakage and secure perfect adhesion. Drains shall be adequately protected from intrusion of concrete into them. Credit for this work is included in the several items for drains and metal work.

8-20. Measurement and credit. - a. Portland cement (Item 16). - (1) The quantity to be credited under Item 16 will be the number of barrels of cement used in all parts of the work unless specifically

excepted. For purposes of credit, a barrel of cement shall be considered 376 pounds net of cement. Credit for the cement shall include all expenses incidental to delivering the cement upon the work in which it is to be used.

(2) All cement furnished for concrete work to be done will be credited under Item 16, "Cement", but the cement used for mortar and grout in pipe joints and other features will be included in the credit for such pipe work and other features.

b. Concrete (Items 17, 18 and 19). - See Section IX.

c. Steel reinforcement (Item 20). - (1) The Area Engineer will be supplied with detail drawings and bending schedules of steel reinforcement by the District Engineer.

(2) The quantity to be credited under Item 20 will be the number of pounds of steel placed in accordance with the drawings or as directed by the District Engineer, measured as specified. It will not include any waste material due to the fact that the lengths supplied are too long for their purpose. The quantity to be credited will, however, include extra metal in laps, where authorized, due to the fact that single bars would be unreasonably long. In computing the weights, the theoretical weight of plain bars will be used as tabulated in Federal Specification QQ-B-71a for the lengths placed as required. For expanded metal reinforcement of the type specified as an alternate for horizontal reinforcement in walls one square foot shall be assumed to weigh 1.02 pounds. For wire mesh reinforcement of the type specified and required for concrete pavement, one square foot shall be assumed to weigh 0.65 pound. Wire or metal clips, and other supports necessary to hold the steel in place will not be considered as reinforcement but shall be furnished by the Area Engineer without additional credit. Credit for Item 20, "Steel Reinforcement", shall include the furnishing, bending, cutting, placing, fastening in position, coating and protecting the reinforcement, and all other work and materials connected therewith. (See Paragraph 8-18 a.)

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SECTION IX. CONCRETE STRUCTURES (Items 17-19 incl.)

9-01. General. - a. Description. - Concrete structures shall be constructed as shown on the drawings and in accordance with modifications designated by the District Engineer. Concrete shall conform to all the requirements of Section VIII for concrete of the class specified. Surfaces of concrete shall be finished as specified in Paragraph 8-15, except as otherwise specified in this section or indicated on the drawings.

b. Measurement and credit. - The quantities to be credited under Items 17-19, inclusive, will be the number of cubic yards or square yards, as specified, of concrete satisfactorily placed within the required limits. No deductions shall be made for openings having a cross-sectional area less than that of a 12-inch pipe, nor for the space occupied by reinforcing steel, miscellaneous metal, wood nailing strips, or by other materials required to be built into the concrete. Credit shall include all costs of furnishing materials, erecting and removing forms, mixing and placing concrete, except that cement, reinforcing steel and other metal work are included under other items. (See Paragraph 8-20).

9-02. Concrete in stop-log structure (Item 17). - a. Description. - This classification includes the Class "A" concrete for the stop-log structure placed between the limiting lines and grades, and in the required location, as shown on the drawings or directed by the District Engineer. Forms for exposed surfaces shall be in accordance with Paragraph 8-17. Concrete fins formed on exposed surfaces shall be removed after the forms are stripped. Piping and miscellaneous metal work shall be set and concreted in place as provided for on the drawings.

b. Measurement and credit. - The volume of concrete to be credited will be the volume computed between the limiting lines and grades, as shown on the drawings or directed by the District Engineer. Credit shall include Class "A" concrete placed under Item 17, "Concrete in Stop-Log Structure."

9-03. Concrete in miscellaneous structures (Item 18). - a. Description. - This classification includes the Class "A" concrete for seep rings, and all other Class "A" concrete in miscellaneous structures, not included in any other item, placed between the limiting lines and grades, and in the required locations, as shown on the drawings or directed by the District Engineer. Piping and miscellaneous metal work shall be set and concreted in place as provided for on the drawings.

b. Measurement and credit. - The volume of concrete to be credited will be the volume computed between the limiting lines and grades, as shown on the drawings or directed by the District Engineer. Credit shall include Class "A" concrete placed under Item 18, "Concrete in Miscellaneous Structures."

9-04. Concrete in road and sidewalk paving (Item 19). - a. Description. - This classification includes Class "A" concrete required for road and sidewalk paving as shown on the drawings or directed by the District Engineer. The concrete paving shall be constructed on a prepared and compacted subgrade in one course, and includes furnishing and placing bituminous joint filler as shown on the drawings or as directed by the District Engineer. The concrete shall be struck off with a template and hand finished to a smooth, even surface by means of wood floats or other approved means. As soon as finished, the concrete shall be protected by heavy burlap and properly cured (see Paragraph 8-16).

b. Measurement and credit. - The quantity to be credited will be the number of square yards of concrete paving placed to the specified lines and grades in the completed work. Credit will be made under Item 19, "Concrete in Road and Sidewalk Paving" and shall include all incidental costs of preparing the subgrade prior to placing the concrete, not included in any other item.

SECTION X. METALS AND EMBEDDED ITEMS (Items 21 and 22).

10-01. General. - a. All metals, unless otherwise specified, shall conform to applicable Federal Specifications, and, when not covered thereby, to applicable A.S.T.M. specifications. All castings shall have the pattern or mark number cast on them. Unless otherwise authorized by the District Engineer, the scale weights of each casting or forging after machining shall be within 5 per cent of the weights as calculated from the dimensions specified or shown on the drawings. Castings shall conform, at the minimum section thereof, to the following dimensional tolerances; where embedded in concrete, to within 1/8 inch; where not embedded in concrete, to within 1/16 inch of the dimensions shown on the drawings.

b. The various articles shall be furnished and placed as indicated on the drawings, unless otherwise directed by the District Engineer. The more important articles required are listed below and are required at the stop-log structure or elsewhere, but other articles, whether or not shown on the drawings, becoming necessary in the development of detailed plans and satisfactory construction, shall also be furnished.

10-02. Materials and workmanship. - The articles included in Items 21 and 22, other miscellaneous materials, and all metals required in the work except as otherwise specified, shall meet the requirements of the following specifications where applicable to the use intended:

(1) Structural steel: - Federal Specification QQ-S-711a; shapes, plates, bars, pins, and bolts shall be Class "A", and rivets shall be Class "C", unless otherwise required. Welding will be accepted only where specified or authorized, and approved only when done in accordance with the current requirements of the American Bureau of Welding.

(2) Cold-rolled steel: - A.S.T.M. Specifications A-108-36 for "Commercial Cold-finished Bar Steels and Cold-finished Shafting". Unless otherwise specified this material shall be used for rods, pins, keys, and similar parts.

(3) Steel castings: - Federal Specification QQ-S-681a.

(4) Iron castings, gray: - Federal Specification QQ-I-651, class as indicated. Tensile tests and chemical analysis will not be required.

(5) Bolts, screws, and washers: - Appropriate Federal Specification and current standard practice, unless otherwise specified.

(6) Wrought-iron bars and shapes: - Federal Specification QQ-I-686, Grade "B".

(7) Cast-iron pipe: - A.S.T.M. Specifications A-44-04, Class A; for soil pipe refer to Federal Specification WW-P-401.

(8) Zinc coatings (hot galvanized):- Federal Specification QQ-I-696.

(9) Other items, unless otherwise specified, shall conform to current standard practice for the material required and use intended.

10-03. Galvanizing and painting. - a. Galvanized iron or steel articles, shall be galvanized by the hot-dip process unless otherwise permitted. Injuries to the galvanizing shall be satisfactorily repaired. Provisions shall be made for the protecting of threads either by counterboring fittings, so as to cover threads or by cutting threads so as to make a very loose fit before galvanizing and carefully rerunning threads after galvanizing so as to leave a good coating all over threads. Hot galvanizing shall be of such quality as to endure at least 4 one-minute immersions in copper sulphate solution, in accordance with the requirements of the Preece test.

b. Except as otherwise specified all metal to be exposed in the finished work shall be thoroughly cleaned and then thoroughly and evenly painted with one coat of red lead paint and two coats of an approved lead-and-oil paint to the satisfaction of the District Engineer. No painting shall be done until the condition of the surface to be painted has been approved. The paint shall be applied by either brush or spray in a neat, thorough, and workmanlike manner, and in no event shall any paint be applied in freezing, rainy, or misty weather. The paint used shall conform to the requirements of Federal Specifications of Groupt "TT"; and samples of paint shall be submitted to the District Engineer for approval and selection.

10-04. Miscellaneous structural steel (Item 21). - a. The required structural steel items shall be furnished and installed as shown on the drawings. Miscellaneous structural steel shapes shall be provided and installed as shown on the drawings, and shall be securely anchored to the concrete structures as directed by the District Engineer.

b. Credit will be made as specified in Paragraph 10-06.

10-05. Miscellaneous iron and steel (Item 22). - a. Frames and gratings, ladders and other miscellaneous iron and steel items as shown on the drawings shall be furnished and installed.

b. Credit will be made as specified in Paragraph 10-06.

10-06. Measurement and credit. - a. The quantities to be credited under Items 21 and 22, will be the number of pounds respectively furnished and installed in accordance with the drawings and specifications.

Wherever practicable, the quantities shall be determined by weighing the articles and materials. When weighing is not practicable, the actual weight of each part or item involved will be determined by the District Engineer, who will use for that purpose manufacturers' weights, catalog weights, and computed weights. The weight of all tare, packing, and blocking will be deducted, using only net weights for credit quantities; provided, that no credit will be made for any weight in excess of 5 per cent more than the computed weight as determined from the drawings.

b. In calculating computed weights the following unit weights of the several materials will be used unless otherwise specified:

Structural Steel - 0.2833 pounds per cubic inch.
Cast Iron - 0.2604 pounds per cubic inch.
Wrought Iron Pipe - The weight per linear foot shown in Table I of Federal Specification WW-P-441.
Black Steel Pipe - The weight per linear foot shown in Table I of Federal Specification WW-P-403.

SECTION XI. MISCELLANEOUS (Items 23 to 32 incl.)

11-01. Timber stop-logs (Item 23). - a. Work included. - Creosoted timber stop-logs shall be furnished and installed for the stop-log structure at the location shown on the drawings or stored as directed by the District Engineer.

b. Materials. - (1) Creosoted timber shall be No. 1 Common plain white oak conforming with the Standard Grading and Dressing Rules of the National Hardwood Lumber Association and to Federal Specification MM-L-736, "Lumber and Timber; Hardwood." Timber shall be treated with a creosote-coal-tar-solution conforming to Federal Specification TT-W-566, "Wood-Preservative; Creosote-Coal-Tar-Solution (for) Ties and Structural - Timbers." (See Specification No. 5-b of the American Wood Preservers' Association). Timber shall be treated by the pressure process in accordance with Federal Specification TT-W-571a, "Wood-Preservative; Preservative-Treatment." The minimum absorption of preservative shall be 6 pounds per cubic foot by the empty cell treatment (see specification for treatment, American Wood Preservers' Association Specification No. 3-b).

(2) For bolts and other necessary hardware, see Section X.

c. Installation. - Stop-logs shall be carefully framed to fit the stop-log structures, and shall be installed as shown on the drawings or stored as directed by the District Engineer.

d. Measurement and credit. - Measurement for credit will be based on the number of thousand feet board measure furnished and installed or stored. Credit will be made under Item 23, "Timber Stop-Logs," and shall include all costs of furnishing, treating and installing or storing timber stop-logs. All bolts, nuts, washers or other hardware necessary for proper construction and installation, will be credited as specified in Section X.

11-02. Placing topsoil and sodding embankment slope (Items 24 and 25). - a. Work included. - The Area Engineer shall furnish and place topsoil on the slopes of the earth dikes as shown on the drawings, and on other areas as required by the District Engineer. The words "soil" or "topsoil" shall mean the material composing the surface layers of the ground containing varying amounts of organic matter. Under Item 24, acceptable topsoil shall be placed to the required depth over the required areas. Under Item 25, the prepared topsoil surface shall be sodded and seeded when and as directed by the District Engineer.

b. Placing topsoil. - After the earth dikes have been completed to required height and dimensions, the Area Engineer shall apply the stored topsoil (see Paragraph 3-01 b) or additional acceptable

topsoil if required, to the required depth when compacted, over the slopes of the embankment to the limits shown on the drawings. The topsoil shall be lightly rolled or tamped and any unevenness of surface shall be corrected to conform to finished grades.

c. Sodding. - (1) The slopes of the earth dikes shall be planted by spot sodding with living sods of Bermuda or some other acceptable grass which will best meet the climatic conditions as approved by the District Engineer. Each sod shall have an area of not less than 16 square inches. Sods shall be placed not more than 18 inches center to center for the minimum-sized sods; larger sods may be spaced proportionately, depending on their size. Sods shall be covered with one-half to one inch of earth, in such manner as to protect the roots from drying out. Sods shall be placed as soon as practicable after cutting, and newly placed sods shall be kept moistened by sprinkling when and as required by the District Engineer until the completion and final acceptance of the work.

(2) Sodding shall be commenced immediately upon completion of the dikes to final grade and cross section and shall be prosecuted at a rate satisfactory to the District Engineer. Seeding shall be done to supplement the sodding operations.

d. Seeding. - (1) Preparation. - All grass or cover crop seed shall be sown when directed by the District Engineer so as to secure the greatest possible protection against erosion. The finished surface grade of the slopes shall be maintained in a true and even condition during the seed-sowing operation, and the Area Engineer shall rake the soil to a depth of three-quarters of an inch (3/4") by using iron rakes immediately previous to sowing seed. All raking shall be done in a direction parallel to the contour lines on the slope and not uphill or downhill. All sticks, stones, weeds or trash appearing on the surface shall be removed.

(2) Seed mixture. - The following mixture will be approved for each acre of seeding:

Perennial Rye Grass	7 lbs.
Orchard Grass	15 lbs.
Hard Fescue	4 lbs.
Kentucky Blue	6 lbs.
Sheep Fescue	6 lbs.
Timothy	7 lbs.
Perennial Red Clover	4 lbs.
White Clover	4 lbs.
Red Top	7 lbs.
Total per acre	60 lbs.

For all seeded areas, about 15 pounds of oats per acre shall be added if the planting is done between the middle of June and the middle of

September, and about 15 pounds of winter rye per acre shall be added if the planting is permitted and done in the late season after the middle of September.

(3) Method of seeding. - The Area Engineer shall take advantage of favorable weather and shall employ a method of sowing satisfactory to the District Engineer. The seed shall be raked in and the whole surface then lightly rolled. Seeding shall be done immediately after the preparation of the earth surface unless otherwise directed. If there be any delay, and if weeds grow in and with the grass, such weeds shall be cut before they go to seed or at such time as directed by the District Engineer. If any loam is washed away or any portions of the seeded areas are not covered by grass, the Area Engineer shall replace the topsoil, fertilize and re-seed.

(4) Maintenance. - The Area Engineer shall maintain the areas sown to grass seed on each section of the project, until all work on this section has been completed and accepted by the District Engineer. This maintenance shall consist of occasional mowing with a scythe or mechanical mower, watering during periods of drought, and removal of conspicuous weeds, or any other similar operations whenever required by the District Engineer. The turf areas shall be fertilized with an acceptable commercial lawn fertilizer of a quality equal to Vigoro or Scott's lawn fertilizer at the customary quantity per acre recommended by the manufacturer.

e. Measurement and credit. - (1) The quantity of topsoil to be credited under Item 24 will be the number of cubic yards actually placed in accordance with directions, measured after compacting whether obtained from stock-piles or from other sources by the Area Engineer. Credit shall include the costs of all labor, materials and expenses incidental to furnishing and placing the topsoil. Credit will be made under Item 24, "Topsoil".

(2) The quantity to be credited under Item 25 will be the number of acres sodded and seeded. Credit shall include all costs for sodding and seeding as specified in subparagraphs c and d above, and for all materials and expenses incidental thereto. Credit will be made under Item 25, "Sodding and Seeding".

11-03. Gravel surfacing for top of dike (Item 26). - a. Work included. - The Area Engineer shall furnish and place gravel, or crushed stone if approved by the District Engineer, of the sizes and quality specified or directed with a clay binder for the surfacing of the top of the dike, as shown on the drawings or as directed by the District Engineer.

b. Material. - The gravel or crushed stone shall be composed of hard, durable stones, free from thin or elongated pieces, and mixed with sand and clay or other approved binding material. The gravel or crushed stone shall be of such sizes that all will pass through a screen

with 3/4-inch square openings, and not less than 35 per cent will be retained on a screen with 1/4-inch square openings, and shall be uniformly graded. The finer material shall consist of sand and clay or other binding material approved by the District Engineer. Should the material as received for the work fail to maintain suitable proportions of coarse and fine particles, or should the coarse particles not be uniformly graded between the maximum and minimum sizes as specified, it shall be screened or mixed in such a manner as to furnish a material to meet the above requirements.

c. Placing. - (1) The surfacing shall be placed in one layer, and shall be 6 inches thick after compaction. After the subgrade or foundation shall have been properly prepared and compacted and proper drainage provided, the surfacing shall be spread evenly by means of approved spreader vehicles or trucks. The material as spread shall be well-graded with no pockets of fine material or segregation of large and fine particles. After being spread evenly, the material shall be graded and compacted to the required thickness by rolling with a self-propelled three-wheel roller weighing not less than ten tons, until a firm even surface is obtained. If at any time the material does not contain a sufficient amount of moisture to insure proper binding of the material, water shall be added by means of a sprinkling wagon or any approved method in a sufficient amount to obtain the desired results.

(2) Compacting of the material shall start longitudinally at the side and gradually proceed toward the center of the roadway so far as practicable, overlapping on successive trips. During the process of compacting the material shall be dragged; the dragging and compacting shall continue until the surfacing does not creep or wave under the roller.

d. Shoulders. - Shoulders shall be constructed as shown on the drawings and carefully maintained. Before the completion of the work the shoulders shall be reformed, trimmed, and dressed as required by the District Engineer.

e. Measurement and credit. - The quantity to be credited under Item 26 will be the number of cubic yards of surfacing furnished in accordance with directions within the limits designated, measured in place after compacting. Credit will be made under Item 26, "Gravel Surfacing for Top of Dike."

11-04. Gravel for roads. (Item 27). - a. Work included. - The Area Engineer shall furnish and place gravel, or crushed stone if approved by the District Engineer, of the sizes and quality specified or directed with a clay binder for the foundation courses and shoulders of roadways, to the lines and grades shown on the drawings.

b. Material. - The gravel or crushed stone shall be composed of hard, durable stones, free from thin or elongated pieces, and mixed

with sand and clay or other approved binding material. The gravel or crushed stone shall be of such sizes for the bottom layer that all will pass a screen with 3-inch square openings and not less than 40 per cent will be retained on a screen with 1/4-inch square openings; and for the top layer all will pass through a screen with 3/4-inch square openings, and not less than 35 per cent will be retained on a screen with 1/4-inch square openings; and for either layer it shall be uniformly graded. The finer material shall consist of sand and clay or other binding material approved by the District Engineer. Should the material as received for the work fail to maintain suitable proportions of coarse and fine particles, or should the coarse particles not be uniformly graded between the maximum and minimum sizes as specified, it shall be screened or mixed in such a manner as to furnish a material to meet the above requirements.

c. Placing. - (1) The 12-inch gravel base shall be placed in two layers, a bottom layer and a top layer, each 6 inches thick after compaction. After the subgrade or foundation shall have been properly prepared and compacted and proper drainage provided, the bottom layer of material shall be spread evenly by means of approved spreader vehicles or trucks. The material as spread shall be well-graded with no pockets of fine material or segregation of large and fine particles. After being spread evenly, the material shall be thoroughly compacted, by rolling with a self-propelled three-wheel roller weighing not less than ten tons, until a firm even surface is obtained. After the bottom layer has been properly and satisfactorily compacted, the top layer shall be spread and compacted to the required thickness. If at any time the material does not contain a sufficient amount of moisture to insure proper binding of the material, water shall be added by means of a sprinkling wagon or any approved method in a sufficient amount to obtain the desired results.

(2) Rolling shall start longitudinally at the side and gradually proceed toward the center of the roadway, overlapping on successive trips. During the process of rolling, the material shall be dragged; the dragging and rolling shall continue until the material does not creep or wave under the roller.

d. Shoulders. - Shoulders shall be composed of gravel or crushed stone, practically free from loam and clay and with all stones larger than four inches removed. Before the final completion of the work the shoulders shall be reformed, trimmed, raked and rolled.

e. Measurement and credit. - The quantity to be credited under Item 27 will be the number of cubic yards furnished and placed in accordance with the drawings or as directed by the District Engineer. The material will be measured in place after compacting. Credit will be made under Item 27, "Gravel for Roads" and shall include all expenses incidental to furnishing, placing, rolling or otherwise compacting the gravel or crushed stone.

11-05. Bituminous macadam road surface (Item 28). - a. Work included. - The Area Engineer shall furnish and place the bituminous macadam road surface shown on the drawings, in the locations shown on the drawings or as directed by the District Engineer, after the gravel or crushed stone base shall have been placed in accordance with the drawings and the applicable provisions of Paragraph 11-04. The surface course shall be composed of broken stone and bituminous material, applied by the penetration method, with a bituminous seal coat and covering of pea stone. Care shall be taken not to spatter bituminous material on surfaces adjacent to the work.

b. Materials. - The broken stone for the surface course shall consist of clean crushed rock, thoroughly screened, uniformly graded in size and quality, angular and free from rounded surfaces; and no flat, elongated or otherwise objectionable stone shall be used in quantities considered deleterious by the District Engineer. (See Paragraph 8-07 b(2)). All stone shall meet the following requirements:

No. 1 Stone Square Openings	Per cent passing
2-1/4"	90 - 100
1-1/4"	0 - 40
3/4"	0 - 5

Pea Stone Square Openings	Per cent Passing
1/2"	90 - 100
1/4"	0 - 20

The bituminous material to be used in this work shall be an approved product for the purpose, either oil asphalt or refined tar. (Refer to Federal Specification R-T-121 for grades TP-1-25 or TP-2-25).

c. Placing. - (1) Shoulders shall be relined and graded before the surface course is spread, in order to hold the broken stone in place and to permit the roller to lap at least one-half the width of the rear wheel when rolling the edge of the top course. A course of No. 1 stone shall then be spread upon the prepared base course to the ordered depth and dry rolled. The rolling shall be done by a suitable roller. Before the No. 1 stone is spread, the pea stone shall be deposited along the shoulders in convenient piles, from which it shall be spread on the surface course as directed. No hauling will be permitted over the No. 1 stone after it has been spread.

(2) The No. 1 stone shall be spread from approved self-spreading vehicles. The course shall be spread and shaped to a true section of such depth that when the surface is finished, the depth shall be as shown on the drawings and the top surface shall be at the required

grade. Rolling shall continue until the course has been satisfactorily compacted to a uniform surface. Any depressions or irregularities which may occur shall be filled with broken stone as directed, and again rolled until the surface is true and unyielding. Precautions shall be taken to prevent the depositing of dirt or other materials in the voids of the broken stone.

(3) No bituminous material shall be applied on stone which has become coated or mixed with dirt or foreign substances. No bituminous material shall be applied unless the entire depth of No. 1 stone is thoroughly dry and the air temperature is at or above 50 degrees F. After the No. 1 stone has been prepared as above, the penetration coat of bituminous material shall be applied at the rate of 2 gallons per square yard by an approved pressure distributor, at approved temperatures appropriate for the grade of bituminous material used, and distributed under approved pressures of from 40 to 60 pounds per square inch.

(4) Immediately after the penetration coat of bituminous material has been applied, a thin layer of clean, dry pea stone shall be broadcast over the treated surface in such quantity as to fill all the surface voids and just cover the treatment uniformly. The surface shall then be broomed to break up all clumps and produce a uniform covering, after which the pavement shall be rolled, in the same manner as specified for the rolling of No. 1 stone, until thoroughly compacted and bonded. Additional pea stone shall be applied as required and directed. Upon completion of the rolling the pavement shall have a smooth, even surface, free from ruts, depressions, or other irregularities.

(5) As soon as practicable after the pea stone has been rolled, the pavement shall be swept clean of any loose material and shall be treated with a seal coat of bituminous material under the same conditions and in the same manner as specified for the penetration coat; except, that the rate of application shall be as directed by the District Engineer but shall not exceed 3/4 gallon per square yard. Immediately after the seal coat has been applied, a thin layer of clean dry pea stone shall be broadcast over the surface in such quantity as to uniformly cover the surface with all the stone that can be made to adhere to the bituminous material, care being taken to avoid an excess. This stone shall be broomed and rolled in the manner specified above, until an unyielding, uniform and well-bonded surface is produced. Any damage to the finished surface caused by the working equipment or otherwise, shall be satisfactorily repaired.

d. Measurement and credit. - The quantity to be credited under Item 28 will be the number of square yards of bituminous macadam road surface of the required quality and thickness satisfactorily placed in the work, measured after placing. Credit will be made under Item 28, "Bituminous Macadam Road Surface". Credit shall include all costs of furnishing materials, equipment, tools, labor and all work incidental to satisfactory construction.

11-06. Manholes (Item 29). - a. Work included. - The Area Engineer shall construct manholes at the points indicated on the drawings, or as directed by the District Engineer.

b. Description. - (1) Manholes shall be built of brick masonry on concrete bases. They shall conform in shape, size, dimensions and in other respects to the details indicated on the drawings. Excavation for the manholes shall comply with the provisions of Paragraph 3-04, as far as they are applicable.

(2) The Area Engineer shall furnish all the materials required for the construction of the manhole, including bricks, cement, sand, hydrated lime, waterproofing compound, concrete, cast iron manhole frames, covers and steps, steel reinforcement and all other materials required. For cast iron frames, covers and steps see Paragraph 10-05. The concrete for manhole bases shall be Class "A" and shall comply with the applicable provisions of Section VIII. All steel bars used for reinforcement of concrete shall conform to the provisions of Paragraph 8-18.

c. Brick masonry. - (1) Kind of brick. - The brick shall be good, sound, hard and uniformly burned brick, regular and uniform in shape and size, of compact texture and satisfactory to the District Engineer. Brick shall comply with Federal Specification SS-B-691, Grade B, standard size 2-1/4 x 3-3/4 x 8 inches. In case the District Engineer rejects any brick, the same shall be immediately removed from the work and brick satisfactory to the District Engineer, substituted. Brick shall be culled and compactly piled as soon as delivered.

(2) Mortar for brickwork. - The mortar shall be composed of one part Portland cement and 2-1/2 parts sand, to which approximately 20 pounds of hydrated lime shall be added for each sack of cement. All mortar used shall be thoroughly mixed either by hand or in a mechanical batch mixer. Mortar shall be prepared in such quantities that it can be used entirely before it has attained its initial set. The minimum amount of water sufficient to make a workable mortar shall be used. Cement and sand used in mortar shall meet the requirements of Paragraphs 8-05 and 8-06. The hydrated lime shall be of approved commercial quality suitable for the use intended.

(3) Brick laying. - The bricks shall be clean and shall be thoroughly wetted shortly before they are put into the wall and each brick shall be laid in a full bed and joint of mortar, without requiring subsequent grouting, flushing or filling, and shall be thoroughly bonded as directed. Brickwork shall be satisfactorily protected against weather and frost until the mortar has set.

(4) Plastering. - Outside faces of brick masonry shall be plastered with Portland cement mortar. The thickness of the cement mortar plaster shall be from 1/4 inch to 3/8 inch and the mortar shall

be carefully spread and thoroughly troweled, leaving a smooth exterior surface. The plaster shall be coated with 2 coats of approved bituminous waterproof coating brushed or sprayed on.

d. Iron castings. - (1) Installation. - Cast-iron steps shall be as detailed on the drawings. The manhole covers and frames shall be of the size and design shown on the drawings.

(2) Painting castings. - New castings before being shipped from the foundry shall be given one coat of coal tar pitch varnish applied in a satisfactory manner so as to make a smooth coating, tough, tenacious and not brittle or with any tendency to scale off.

e. Credit. - (1) Credit under Item 29, "Manholes", shall include all costs for furnishing the materials, equipment, and labor required to construct the manhole complete to the lines and grades shown on the drawings, together with plastering of outside faces as described in Paragraph 11-06 c(4), except the cost of excavation and backfilling.

(2) Credit for excavation will be made under Item 3 (see Paragraph 3-06 d(2)). Credit for backfilling will be made under Item 12 (see Paragraph 6-03 d).

11-07. Highway cable guard rail (Item 30). - a. Work included. - The Area Engineer shall furnish and install cable guard rail at the locations shown on the drawings or as directed by the District Engineer.

b. Materials. - (1) Posts shall be constructed of Class "A" concrete to the sizes and dimensions as shown on the drawings. The maximum size of coarse aggregates shall not exceed one inch in size. The reinforcement shall conform to the requirements of Paragraph 8-18.

(2) The wire rope shall be 3/4-inch diameter, conforming to the requirements of Federal Specification RR-R-571 and subsequent amendments thereof, Type III, 3 by 7 wire rope, annealed steel, galvanized.

(3) All fittings for highway cable guard rail, except anchor rods, nuts and washers, shall be of galvanized drop forgings, conforming to Class "B" of A.S.T.M. Designation A18-30. Nuts and washers shall conform to Paragraph 10-02. The cables shall be fastened to the concrete posts with offset fittings and to the anchor blocks with an equalizing take-up anchorage as shown on the drawings. The fasteners on the end posts and on the posts where intermediate anchorages are made shall be steel provided with a bearing bracket. Each cable shall be attached to its respective socket by hot zinc socketing conforming to Federal Specification RR-R-571.

c. Construction methods. - The posts for the highway cable guard rail shall be spaced and securely set and the cable strung as shown on the drawings or as directed by the District Engineer. Backfilling shall be thoroughly tamped into place. Each anchor and end post shall have a footing of concrete or a single stone at least 12 inches square and four inches thick as shown on the drawings. The cable shall be drawn taut and anchored by a precast concrete anchor block or other anchorage approved by the District Engineer. Dummy posts, other than those at the ends of cable guard rails, shall be placed to mark culverts or elsewhere as ordered. After erection all exposed surfaces of the posts shall receive a uniform application of a solution consisting of 8 pounds of zinc sulphate to one gallon of water. This application shall be allowed to act for at least 48 hours after which the posts shall be brushed thoroughly to remove any surface crystals of zinc sulphate. The posts, when perfectly dry, shall receive two coats each of white paint and black paint as directed. The black paint shall extend from the ground up to the bottom cable. The posts shall be thoroughly dried out and aged before the application of any paint materials.

d. Measurement and credit. - The quantity to be credited under Item 30, "Highway Cable Guard Rail," will be the number of linear feet of cable guard rail satisfactorily completed in accordance with the requirements of Paragraphs 11-07 b and c. Credit shall include all materials, equipment, tools, labor and work incidental thereto; also all excavations for posts, backfilling and disposal of surplus materials. The measurement will be made from outer post to outer post to which cable is attached with an additional allowance of 20 feet to cover the cost of anchoring at each anchor block, and to cover the cost of dummy posts to be set at anchor blocks at ends and with an additional allowance of 5 feet for each dummy post set other than those at the ends of the cable guard rail.

11-08. Granite curb (Item 31). - a. Work included. - The Area Engineer shall reset granite curbing, in the locations and to the lines and grades, as shown on the drawings or as directed by the District Engineer.

b. Materials. - All existing curbing obtained from excavation and removal of structures (see Paragraph 3-07 a), which is acceptable to the District Engineer shall be used. Any existing curbing not acceptable for use due to the fault or negligence of the Area Engineer shall be replaced by the Area Engineer with new curbing of equal quality and appearance without additional credit. The mortar for pointing shall be composed of one part Portland cement and 2-1/2 parts sand, and shall conform to the requirements for mortar for laying tile drains (see Paragraph 7-01 c (2)).

c. Construction methods. - The stones shall be set to the required line and grade on a prepared and compacted subgrade as shown on the drawings, with joints not exceeding 3/8 inch. The joints shall be pointed with mortar. If directed by the District Engineer, all joints and tops shall be redressed before pointing, to obtain a smooth top surface and even joints.

d. Measurement and credit. - The quantity to be credited will be the number of linear feet of curb reset, complete in place. Credit will be made under Item 31, "Granite Curb," and shall include all costs of preparing the subgrade, setting, redressing, pointing and backfilling the granite curbing.

11-09. Cast iron pipe, 12-inch (Item 32). - a. Work included. - The Area Engineer shall furnish and install the 12-inch cast iron pipe at the stop-log structure as shown on the drawings or as directed by the District Engineer.

b. Materials. - Cast iron pipe shall be flange-and-spigot pipe conforming to the requirements of the current American Water Works Association specifications for the standard weight pipe, Class "A". Each pipe shall be carefully inspected immediately before laying and no cracked, broken or otherwise imperfect pipe shall be used, except for minor defects which in the opinion of the District Engineer do not impair the fitness of the pipe for the purpose intended.

c. Installation. - The provisions of Paragraphs 7-03 c and 7-04 c shall apply as applicable. The backfill material as shown on the drawings shall be evenly spread and compacted around and over the pipe to the limits shown on the drawings or as directed by the District Engineer.

d. Measurement and credit. - (1) Measurement for credit will be based on the linear feet of pipe installed. Credit will be made under Item 32, "Cast Iron Pipe, 12-Inch," and shall include all costs of furnishing and installing pipe and connections, except the cost of excavation and backfilling.

(2) Credit for excavation will be made under Item 3 (see Paragraph 3-04). Credit for backfilling will be made under Item 12 (see Paragraph 6-03 d).

11-10. Cleaning up. - a. Work included. - The Area Engineer shall remove all construction equipment and all temporary structures built or used by him, shall remove rubbish of all kinds from the site of the work, and from any grounds which he shall have occupied within the limits of the work, and shall leave the site of the work in a clean condition satisfactory to the District Engineer. All materials salvaged shall be the property of the Government, unless otherwise designated by the District Engineer.

b. Credit. - For all work, materials and incidentals required to clean up as set forth in a above, the Area Engineer will receive no direct credit, but credit shall be considered as having been included under Items 1 to 32, inclusive.

UNITED STATES ENGINEER OFFICE,
PROVIDENCE, RHODE ISLAND.
JANUARY 15, 1940.